

BID DOCUMENTS

HANGAR DEVELOPMENTS

MARIANNA MUNICIPAL AIRPORT—CITY OF MARIANNA, FL

PREPARED FOR:

**CITY OF MARIANNA
CITY COMMISSION**
2895 JEFFERSON STREET
MARIANNA, FL 32446
PHONE: (850) 482-4129

PREPARED BY:



AVCON, INC.
ENGINEERS & PLANNERS
320 BAYSHORE DR, SUITE A
NICEVILLE, FL 32578
PHONE: (850) 678-0050

MARCH 2024

AVCON PROJECT: 2022.260.03

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FRONT END DOCUMENTS

**BID DOCUMENTS
HANGAR DEVELOPMENTS
MARIANNA MUNICIPAL AIRPORT, MARIANNA, FLORIDA**

NOTICE TO BIDDERS
HANGAR DEVELOPMENTS
at
MARIANNA MUNICIPAL AIRPORT
MARIANNA, FLORIDA

Notice is hereby given that the City of Marianna City Commission will receive sealed bids at City Hall, 2895 Jefferson Street, Marianna, Florida 32446 (office: 850-482-4353) until 2:00 PM local time on Tuesday, April 30, 2024, for the HANGAR DEVELOPMENTS project at Marianna Municipal Airport. All bids will be publicly opened and read aloud. Bids must be submitted in a sealed envelope clearly marked "BID ENCLOSED: HANGAR DEVELOPMENTS, MARIANNA MUNICIPAL AIRPORT." The project generally includes, but is not necessarily limited to the following tasks:

New approx. 12,000 sf aircraft hangar with an additional 3,000 sf of offices. Site work includes asphalt parking lot, concrete apron, and stormwater and utility improvements.

Beginning on Thursday, March 28, 2024, bidding documents may be examined at City Hall, 2895 Jefferson Street, Marianna, Florida 32446. Digital copies of the above documents may be obtained from the office of AVCON, INC., 320 Bayshore Drive, Suite A, Niceville, Florida 32578 (office: 850-678-0050). Hard copies of the above documents may be provided at cost. Questions relating to the Bid Documents shall be submitted to the Engineer no later than Tuesday, April 16, 2024.

Bid security in the amount of at least five percent (5%) of the total bid must be submitted with the bid. The bid security may be either a certified check or a proposal guaranty bond executed by a surety company authorized to do business in the State of Florida. Bid security shall be made payable to the City of Marianna. The successful bidder must be able to furnish a 100% Performance Bond and a 100% Labor and Materials Payment Bond and shall begin execution of this contract within five (5) calendar days following the date of the Notice to Proceed. The City of Marianna has established a Disadvantaged Business Enterprise (DBE) goal for this project. The DBE participation goal for this project is 5% and compliance requirements are listed in the bidding documents.

The successful contract will be required to comply with all provisions of the Federal Government Equal Employment Opportunity clauses issued by the Secretary of Labor on May 21, 1968 and published in the Federal Register (41CFR Part 60-1, 33 F.2 7804). The successful contractor must comply with the Occupational Safety and Health Act, the Contract Work Hours and Safety Standards Act (CWHSSA), Title VI of the Civil Rights Act of 1964 and Executive Order 11246.

A non-mandatory Pre-Bid Conference will be conducted at the Terminal Building of the Marianna Municipal Airport at 3689 Industrial Park Drive, Marianna, Florida 32446 on Monday, April 8, 2024 at 11:00 a.m. local time (CDT). Questions relating to the Project Documents will be answered at that time. Attendance by prospective prime contractors is strongly recommended.

OWNER'S CONTACT:

Douglas Glass
City of Marianna
2895 Jefferson Street
Marianna, Florida 32446
Tel: 850-482-4129

ENGINEER'S CONTACT:

John Collins, P.E., Senior Project Manager
AVCON, INC.
320 Bayshore Drive, Suite A
Niceville, Florida 32578
Tel: 850-678-0050

All bids shall be sealed and shall be addressed as follows:

City of Marianna
2895 Jefferson Street
Marianna, Florida 32446

BID ENCLOSED: HANGAR DEVELOPMENTS, MARIANNA MUNICIPAL AIRPORT"

Funding for this project is being provided by the Florida Department of Transportation. The City of Marianna reserves the right to reject any and all bids, to waive any technical or legal deficiencies and to accept any bid that it may deem to be in the best interest of the County. No bidder may withdraw his/her bid for a period of 120 calendar days following the bid opening.

INSTRUCTIONS TO CONTRACTORS

PROJECT IDENTIFICATION:

a) Project Title:

HANGAR DEVELOPMENT

b) Owner:

CITY OF MARIANNA

c) Engineer:

AVCON, INC.

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1. Defined Terms.

Terms used in the Instructions to Contractors that are defined in the Standard General Conditions of the Project Manual have the meanings assigned to them in the General Conditions.

Certain additional terms used in the Instruction to Contractors have the meanings indicated below which are applicable to both the singular and plural thereof.

- 1.1 Contractor – one who submits a Bid directly to Owner as distinct from sub-contractor, who submits a bid to a Contractor.
- 1.2 Issuing Office – the office from which the Project Documents are to be issued and where the bid procedures are to be administered.
- 1.3 Successful Contractor – the lowest, responsible and responsive Contractor to whom Owner (on the basis of Owner's evaluation as hereinafter provided) makes and award.

2. Copies of Project Documents.

- 2.1 Complete sets of the Project Documents in the number and for the sum, if any, stated in the Advertisement or Notice to Contractors may be obtained from the Issuing Office.
- 2.2 Complete sets of Project Documents must be used in preparing Bids; neither Owner nor Engineer assume any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Project Documents.
- 2.3 Owner and Engineer in making copies of Project Documents available on the above terms do so only for the purpose of obtaining Bids for the Work and do not confer a license or grant for any other use.

3. Qualifications of Contractors.

- 3.1 To demonstrate qualifications to perform the Work, each Contractor must submit within two (2) business days after Bid opening upon Owner's request detailed written evidence such as financial data, previous experience, present commitments and other such data as may be called for below. Each Bid must contain evidence of Contractors qualification to do business in the state where the Project is located or covenant to obtain such qualification prior to award of the contract.

4. Examination of Documents and Site.

- 4.1 It is the responsibility of each contractor before submitting a Bid:
 - 4.1.1. To examine thoroughly these documents and other related data identified (including "technical data" referred to below);
 - 4.1.2. To visit the site to become familiar with and satisfy Contractor as to the general, local and site conditions that may affect cost, progress, performance, or furnishing of the Work;
 - 4.1.3. To consider federal, state, and local Laws and Regulations that may affect cost, progress, performance or furnishing of the Work;

- 4.1.4. To study and carefully correlate Contractors knowledge and observations with these Project Documents and such other related data; and
 - 4.1.5. To promptly notify Engineer of all conflicts, errors, ambiguities or discrepancies which Contractor has discovered in or between these Project Documents and such other related documents.
- 4.2 Reference is made to the Supplementary Conditions for identification of:
- 4.2.1. Those reports of explorations and tests of subsurface conditions at or contiguous to the site which have been utilized by Engineer in preparation of these Project Documents. Contractor may rely upon the general accuracy of the "technical data" contained in such reports but not upon other data, interpretations, opinions or information contained in such reports or otherwise relating to the subsurface conditions at the site, nor upon the completeness thereof for the purposes of the bid or construction.
 - 4.2.2. Those drawings of physical conditions in or relating to existing surface and subsurface structures (except Underground Facilities) which are at or contiguous to the site that have been utilized by Engineer in preparation of these Project Documents. Contractor may rely upon the general accuracy of the "technical data" contained in such drawings but not upon other data, interpretations, opinions, or information shown or indicated in such drawings or otherwise relating to such structures, nor upon the completeness thereof for the purposes of the bid or construction.
- Copies of such reports and drawings will be made available by Owner to any Contractor on request. Those reports and drawings are not part of the Project Documents, but the "technical data" contained therein upon which Contractor is entitled to rely as provided in Paragraph 4.2 of the General Conditions and has been identified and established in Article 4 of the Supplementary Conditions. Contractor is responsible for any interpretation or conclusion drawn from any "technical data" or any such data, interpretations, opinions, or information.
- 4.3 Information and data shown or indicated in these Project 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 or others, and the Owner and Engineer do not assume responsibility for the accuracy or completeness thereof unless it is expressly provided otherwise in the Supplementary Conditions.
 - 4.4 Provisions concerning responsibilities for the adequacy of data furnished to prospective Contractors with respect to subsurface conditions, other physical conditions and Underground Facilities, and possible changes in these Project Documents due to differing or unanticipated conditions appear in Paragraphs 4.2 and 4.3 of the General Conditions.
 - 4.5 Before submitting a Bid each Contractor will be responsible to obtain such additional or supplementary examinations, investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the site or otherwise, which may affect cost, progress, performance or furnishing of the Work or which relate to any aspect of the means, methods, techniques, sequences or procedures of

construction to be employed by the Contractor and safety precautions and programs incident thereto or performing and furnishing the Work in accordance with the time, price, and other terms and conditions of the Contact Documents.

- 4.6 On request, Owner will provide each Contractor access to the site to conduct such examinations, investigations, explorations, tests, and studies as each Contractor deems necessary for submission of a Bid. Contractor must fill all holes and clean up and restore the site to its former conditions upon completion of such explorations, investigations, tests, and studies.
- 4.7 Reference is made to the Supplementary Conditions for the identification of the general nature of 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 for which a Bid is to be submitted. On request, Owner will provide to each Contractor for examination access to or copies of appropriate documents (other than portions thereof related to price) for such work.
- 4.8 The submission of a Bid will constitute and incontrovertible representation by Contractor that Contractor has complied with every requirement of this Article 4, that without exception of the Bid is premised upon performing and furnishing the Work required by these Project Documents and applying the specific means, methods, techniques, sequences, or procedures for construction (if any) that may be shown or indicated or expressly required by these Project Documents, the Contractor has given Engineer written notice of all conflicts, errors, ambiguities and discrepancies that Contractor has discovered in these Project Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performing and furnishing the Work.
- 4.9 The provisions of 1-4.1 through 4.8, inclusive, do not apply to Asbestos, Polychlorinated biphenyls (PCBs), Petroleum, Hazardous Waste, or Radioactive Material covered by Paragraph 4.5 of the General Conditions.

5. Availability of Lands for Work, Etc.

The lands upon which the Work is to be performed, rights-of-way and easements for access thereto and other lands designated for use by the successful Contractor in performing the Work are identified in these Project Documents. All additional land 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 the Successful Contractor. Easements for permanent structures or permanent changes in existing facilities are to be obtained and paid for by Owner unless otherwise provided in these Project Documents.

6. Interpretations and Addenda.

- 6.1 All questions about the meaning or intent of these Project Documents are to be directed to Engineer. Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda mailed, faxed or delivered to all parties recorded by Engineer as having received the Project Documents. Questions received less than ten (10) days prior to the date for opening of Bids may not be answered. Only questions answered by formal written Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

- 6.2 Addenda may also be issued to modify these Project Documents as deemed advisable by Owner or Engineer.

7. Bid Security.

- 7.1 Each Bid must be accompanied by Bid security made payable to Owner in an amount of five percent (5%) of Contractors maximum Bid Price in the form of a certified or bank check or a Bid Bond on form attached, issued by a surety meeting the requirements of Paragraph 5.1 of the General Conditions.

- 7.2 The Bid security of Successful Contractor will be retained until such Contractor has executed the Agreement, 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 Contractor fails to execute and deliver the Agreement and furnishes the required contract security within fifteen days after the Notice of Award, Owner may annul the Notice of Award and the Bid security of that Contractor will be forfeited. The Contractor security of other Contractors whom Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of:

the seventh (7th) day after the Effective Date of the Agreement

or

the thirty-sixth (36th) day after the Bid opening,

whereupon Bid security furnished by such Contractors will be returned. Bid security with Bids which are not competitive will be returned within seven (7) days after the Bid opening.

8. Contract Times.

The number of days within which, or the dates by which, the Work is to be substantially completed and also completed and ready for final payment (the term "Contract Times" is defined in paragraph 1.12 of the General Conditions) are set forth in the Agreement (or incorporated therein by reference to the attached Bid Form).

9. Substitute and "Or-Equal" Items.

The Contract, if awarded, will be on the basis of materials and equipment described in the Drawings or specified and equipment described in the Drawings or specified in the Specifications without consideration of possible substitute or "or-equal" items. Whenever it is indicated in the Drawings or specified in the Specifications 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. The procedure for submission of any such application by Contractor and consideration by Engineer is set forth in Paragraphs 6.7.1, 6.7.2 and 6.7.3 of the General Conditions and may be supplemented in the Supplementary Conditions.

10. Subcontractors, Suppliers, and Others.

- 10.1 If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers and other persons and organizations (including those who are to furnish the principal items of material and equipment) to be submitted to Owner in advance of a specified date prior to the Effective Date of the Agreement, apparent Successful Contractor, and any other Contractor so

requested, shall within 24 hours after Bid opening submit to Owner a list of all such Subcontractors, Suppliers, and other persons and organizations 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, person, or organization if requested by Owner. An Owner or Engineer who after due investigation has reasonable objection to any proposed Subcontractor, Supplier, other person, or organization, may before the Notice of Award is given request apparent Successful Contractor to submit an acceptable substitute without an increase in Bid Price.

If apparent Successful Contractor declines to make any such substitution, Owner may award the contract to the next lowest Contractor that proposes to use acceptable Subcontractors, Suppliers, and other persons and organizations. The declining to make requested substitutions will not constitute grounds for sacrificing the Bid security of any Contractor. Any subcontractor, Supplier, other person or organization listed and to whom Owner or Engineer does not make 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 6.8.2 of the General Conditions.

11. Bid Form.

- 11.1 All blanks on the Bid Form must be completed by printing in ink or by typewriter.
- 11.2 Bids by corporations must be executed in the corporate name by the president or a vice-president (or other corporate officer accompanied by evidence of authority to sign) and the corporate seal must be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation must be shown below the signature.
- 11.3 Bids by partnerships must be executed in the partnership name and signed by a partner, whose title must appear under the signature and the official address of the partnership must be shown below the signature.
- 11.4 All names must be typed or printed in ink below the signature.
- 11.5 The bid shall contain an acknowledgment of receipt of all Addenda (the numbers of which must be filled in on the Bid Form).
- 11.6 The address and telephone number for communications regarding the bid must be shown.
- 11.7 Evidence of authority to conduct business as an out-of-state corporation in the state where the Work is to be performed shall be provided in accordance with Paragraph 3 above. State contractor license number, if any, must also be shown.

12. Submission of Bids.

- 12.1 Contractor shall submit the original plus two (2) copies of their bid to the place indicated in the Advertisement of Notice to Contractor.
- 12.2 Bids shall be submitted at the time and place indicated in the Advertisement of Notice to Contractor and shall be enclosed in an opaque sealed envelope, marked with the Project title

and name and address of Contractor and accompanied by the Bid security and other required documents. If the Bid is sent through the mail or other delivery system the sealed envelope shall be enclosed in a separate envelope with the notation "**BID ENCLOSED – HANGAR DEVELOPMENT, MARIANNA MUNICIPAL AIRPORT** " on the face of it.

13. Modification and Withdrawal of Bids.

13.1 Bids may be modified or withdrawn by an appropriate document duly executed (in the manner that a Bid must be executed) and delivered to the place where Bids are submitted at any time prior to the opening of Bids.

13.2 If, within twenty-four hours after Bids are opened, any Contractor 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 Contractor may withdraw its Bid and bid security will be returned. Thereafter, that Contractor will be disqualified from further bids on the Work to be provided under the Project Documents.

14. Opening of Bids.

Bids will be opened and (unless obviously non-responsive) read aloud publicly at the place where Bids are to be submitted. An abstract of the amounts of the base Bids and major alternates (if any) will be made available to Contractors after the opening of Bids.

15. Bids to Remain Subject to Acceptance.

All Bids will remain subject to acceptance for one hundred twenty (120) days after the day of the Bid opening, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to that date.

16. Disqualification of Contractors

Any of the following reasons may be considered as sufficient for the disqualification of a contractor and the rejection of his proposal or proposals:

- A. More than one proposal for the same work from an individual, firm or corporation under the same or different name.
- B. Evidence that the contractor has a financial interest in the firm of another contractor for the same work.
- C. Evidence of collusion among contractors. Participants in such conclusion will receive no recognition as contractors for any future work of the County until such participant shall have been reinstated as a qualified contractor.
- D. Uncompleted work that in the judgment of the County might hinder or prevent the prompt completion of additional work if awarded.
- E. Failure to pay or satisfactorily settle all bills due for labor and material on former contracts in force at the time of advertisement for bids.
- F. Default under previous contract.

17. Award of Contract.

- 17.1 Owner reserves the right to reject any or all Bids, including without limitation the rights to reject any or all nonconforming, non-responsive, unbalanced, or conditional Bids and to reject the Bid of any Contractor if Owner believes that it would not be in the best interest of the Project to make an award to that Contractor, whether because the Bid is not responsible or the Contractor is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or criteria established by Owner. Owner also reserves the right to waive all informalities not involving price, time, or changes in the Work. 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.
- 17.2 In evaluating Bids, Owner will consider the qualifications of Contractors, 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.
- 17.3 Owner may consider the qualifications and experience of Subcontractors, Suppliers, and other persons and organizations proposed for those portions of the Work as to which the identity of Subcontractors, Suppliers, and other persons and organizations must be submitted as provided in the Supplementary Conditions. Owner also may consider the operating costs, maintenance requirements, performance data and guarantees of major item of materials and equipment proposed for incorporation in the Work when such data is required to be submitted prior to the Notice of Award.
- 17.4 Owner may conduct such investigations as Owner deems necessary to assist in the evaluation of any Bid and to establish the responsibility, qualifications, and financial ability of Contractors, proposed Subcontractors, Suppliers, and other persons and organizations to perform and furnish the Work in accordance with the Project Documents to Owner's satisfaction within the prescribed time.
- 17.5 The Owner in its absolute discretion may reject any bid of a Contractor that has failed, in the opinion of the Owner, to complete or perform an Owner-contracted project in a timely fashion, and emphasizes this condition to potential Contractors.
- 17.6 If a contract is to be awarded, it will be awarded to lowest responsive, responsible Contractor whose evaluation by Owner indicates to Owner that the award will be in the best interests of the Project.

18. Pre-Bid Conference.

A **non-mandatory** Pre Bid Conference will be conducted at the Terminal Building of the Marianna Municipal Airport at 3689 Industrial Park Drive, Marianna, Florida 32446 on Monday, April 8, 2024 at 11:00 a.m. local time (CDT). Questions relating to the Project Documents will be answered at that time. Attendance by prospective prime contractors is strongly recommended.

19. Sales and Use Taxes.

Work under this Bid is subject to the provisions of Chapter 212, Florida Statutes, Tax on state, Use and Other Transactions. Other state, local, or federal taxes may be applicable. The contractor is responsible to remit to the appropriate governmental entity all applicable taxes. Any applicable tax shall be included in the total Bid price by the contractor.

BID DOCUMENTS

BID DOCUMENTS
HANGAR DEVELOPMENTS
MARIANNA MUNICIPAL AIRPORT, MARIANNA, FLORIDA

BID FORM

PROJECT IDENTIFICATION:

HANGAR DEVELOPMENTS

MARIANNA MUNICIPAL AIRPORT

THIS BID IS SUBMITTED TO:

CITY OF MARIANNA

1. The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an agreement with Owner in the form included in these documents to perform and furnish all Work as specified or indicated in these documents for the Bid Price and within the Bid Times indicated in this Bid and in accordance with the other terms and conditions of these documents.
2. Bidder accepts all of the terms and conditions of the Advertisement or Invitation to Bid and Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for one hundred twenty (120) days after the day of Bid opening. Bidder will sign and deliver the required number of counterparts of the Agreement with the Bonds and other documents required by the Bidding Requirements within fifteen (15) days after the date of Owner's Notice of Award.
3. In submitting this Bid, Bidder represents as more fully set forth in the Agreement, that:

- (a) Bidder has examined and carefully studied the Bidding Documents and the following Addenda receipt of all which is hereby acknowledged: (List Addenda by Addendum Number and Date)

Addendum No.: _____ Date: _____

Addendum No.: _____ Date: _____

Addendum No.: _____ Date: _____

Addendum No.: _____ 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, performance, and furnishing of the Work.
- (c) Bidder is familiar with and is satisfied as to all federal, state, and local Laws and Regulations that may affect cost, progress, performance, and furnishing of the Work.
- (d) Bidder has carefully studied all reports of explorations and tests of subsurface conditions at or contiguous to the site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the site (except underground facilities) which have been identified in the Supplementary Conditions as provided in paragraph 4.2.1 of the General Conditions. Bidder accepts the determination set forth in Article 4 of the Supplementary Conditions of the extent of the "technical data" contained in such reports and drawings upon

which Bidder is entitled to rely as provided in paragraph 4.2 of the General Conditions. Bidder acknowledges that such reports and drawings are not Contract Documents and may not be complete for Bidder's purposes. Bidder acknowledges that Owner and Engineer do not assume responsibility for the accuracy or completeness of information and data shown or indicated in the Bidding Documents with respect to underground facilities at or contiguous to the site. Bidder has obtained and carefully studied (or assumes responsibility for having done so) all such additional or supplementary examinations, investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface, and underground facilities) at or contiguous to the site or otherwise which may affect cost progress, performance or furnishing of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder and safety precautions and programs incident thereto. Bidder does not consider that any additional examinations, investigations, explorations, tests, studies or data are necessary for the determination of this Bid for performance and furnishing of the Work in accordance with the times, price, and other terms and conditions of these Documents.

- (e) Bidder is aware of the general nature of Work to be performed by Owner and others at the site that relates to Work for which this Bid is submitted as indicated in these documents.
 - (f) Bidder has correlated the information known to Bidder, information and observation obtained from visits to the site, reports and drawings identified in these documents and all additional examinations, investigations, explorations, tests, studies, and data with these documents.
 - (g) Bidder has given Engineer written notice of all conflicts, errors, ambiguities or discrepancies that Bidder has discovered in these documents and the written resolution thereof by Engineer is acceptable to Bidder, and these documents are generally sufficient to indicate and convey understanding of all terms and conditions for performing and furnishing the Work for which this Bid is submitted.
 - (h) This Bid is genuine and not made in the interest of or on behalf of any undisclosed person, firm, or corporation and is not submitted in conformity with any agreement or rules of any group, association, organization, or corporation; Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; Bidder has not solicited or induced any person, firm or corporation to refrain from bidding; and Bidder has not sought by collusion to obtain for itself any advantage over any other Bidder or over Owner.
4. Bidder will complete the Work in accordance with these documents for the price found in the Bid Schedule:

Unit Prices have been computed in accordance with paragraph 11.9.2 of the General Conditions.

Bidder acknowledges that quantities are not guaranteed and final payment will be based on actual quantities determined as provided in these documents.

5. Bidder agrees that Work associated with the Base Bid will be substantially complete 330 calendar days after the date when the Contract Time commences to run as provided in paragraph 2.3 of the General Conditions. Bidder also agrees that Work associated with the Base Bid will be completed and ready for final payment in accordance with paragraph 14.13 of the general conditions within 360

calendar days after the date when the Contract Time commences to run. If Additive Alternate No. 1 and or 2 are awarded, no additional time will be added to the Substantial and Final Completion times.

6. Bidder accepts the provisions of the Agreement as to liquidated damages in the event of failure to complete the Work within the times specified in the Agreement.
7. The following documents are attached to and made a condition of this Bid and shall be completed and submitted as part of a responsive bid proposal. Bid proposals that do not include the following documents may be considered unresponsive:
 - (a) This bid form (BF-1 to BF-5) fully completed.
 - (b) Bid schedule completed, with bid unit prices indicated numerically and in words (BS-1 to BS-14).
 - (c) Bid Affidavit (BA-1)
 - (d) Bid Security as required by the Instructions to Bidders in the form of a certified or bank check made payable to Franklin County or a Bid Bond on form attached (BB-1 to BB-2), issued by a surety meeting the requirements of Paragraph 5.1 of the General Conditions.
 - (e) Required Bidder's Qualification Questionnaire with supporting data. (BQQ-1 to BQQ-3)
 - (f) Form of Noncollusion Affidavit (NCA-1)
 - (g) Certification of Non-Segregated Facilities (NSF-1)
 - (h) Drug-Free Workplace Certification (DFWC-1)
 - (i) Indemnification and Hold Harmless (IHH-1)
 - (j) Worker's Compensation Affidavit (WCA-1)
 - (k) Buy American Certificate (BAC-1)
 - (l) Sworn Statement under Section 287.133 (3)(a), Florida Statutes, on Public Entity Crimes (SSPEC-1 to SPPEC-3)
 - (m) Disadvantaged Business Enterprise Program (DBEP-1 to DBEP-4)
 - (n) DBE Certificate of Compliance Form (DBECF-1)
 - (o) Insurance Compliance (IC-1)
 - (p) Certificate as to Corp. Principal (CCP-1)
 - (q) Performance of Work by Subcontractors (PWSC-1)
8. Communications concerning this Bid shall be addressed to the address of Bidder indicated below.

9. Terms used in this Bid which are defined in the General Conditions or Instructions to Bidders will have the meanings indicated in the General Conditions or Instructions.

10. The contract award will be awarded to the lowest responsive bidder based on the Bid Schedule ultimately awarded by the City.

SUBMITTED on _____, 20__

State Contractor License No. _____

If Bidder is:

An Individual

By _____ (SEAL)
(Individual's Name)

doing business as _____

Business address: _____

Phone No.: _____

A Partnership

By _____ (SEAL)
(Firm Name)

_____ (General Partner)

Business address: _____

Phone No.: _____

A Corporation

By _____ (SEAL)
(Corporation Name)

_____ (State of Incorporation)

By _____ (SEAL)
(Name of person authorized to sign)

_____ (Title)

(Corporate Seal)

Attest _____
(Secretary)

Business address: _____

Phone No.: _____

Date of Qualification to do business is _____

A Joint Venture

By _____ (SEAL)
(Name)

(Address)

By _____ (SEAL)
(Name)

(Address)

Phone Number and Address for receipt of official communications

(Each joint venturer must sign. The manner of signing for each individual, partnership and corporation that is a party to the joint venture should be in the manner indicated above).

BID SCHEDULE - UNIT PRICES
 (This is a Unit Price Contract)

BIDDER: _____ **DATE:** _____

AIRPORT NAME: _____ MARIANNA MUNICIPAL AIRPORT
PROJECT DESCRIPTION: _____ HANGAR DEVELOPMENTS

BID SCHEDULE

Base Bid – Commercial Hangar

Bid Item No.	Item No.	Item Description & Unit Price In Words	Unit	Estimated Quantity	Unit Price	Total Amt./ Item
1	101-1	<u>Mobilization</u> _____ dollars and _____ cents	LS	1		
2	102-1	<u>Maintenance of Traffic</u> _____ dollars and _____ cents	LS	1		
3	104-1	<u>Prevention, Control, and Abatement of Erosion and Water Pollution</u> _____ dollars and _____ cents	LS	1		
4	110-1	<u>Complete Concrete and Base Removal</u> _____ dollars and _____ cents	SY	435		
5	110-2	<u>Misc. Utility and Fence Demolition</u> _____ dollars and _____ cents	LS	1		

Bid Item No.	Item No.	Item Description & Unit Price In Words	Unit	Estimated Quantity	Unit Price	Total Amt./ Item
6	120-1	<u>Unclassified Excavation and Embankment</u> _____dollars and _____cents	LS	1		
7	160-1	<u>8" Stabilized Subgrade</u> _____dollars and _____cents	SY	1,255		
8	160-2	<u>12" Stabilized Subgrade</u> _____dollars and _____cents	SY	855		
9	204-1	<u>8" Graded Aggregate Base Course</u> _____dollars and _____cents	SY	1,930		
10	204-2	<u>Graded Aggregate (gravel)</u> _____dollars and _____cents	SY	35		
11	334-1	<u>2" Bituminous Surface Course</u> _____dollars and _____cents	TN	127		
12	346-1	<u>10" PCC Apron</u> _____dollars and _____cents	SY	715		
13	425-1	<u>FDOT Type 'F' DBI</u> _____dollars and _____cents	EA	5		

Bid Item No.	Item No.	Item Description & Unit Price In Words	Unit	Estimated Quantity	Unit Price	Total Amt./ Item
14	425-2	<u>ADS yard Drain</u> _____ dollars and _____ cents	EA	6		
15	430-1	<u>12" ADS, N-11</u> _____ dollars and _____ cents	LF	315		
16	430-2	<u>18" ADS, N-12</u> _____ dollars and _____ cents	LF	305		
17	430-3	<u>24" ADS, N-12</u> _____ dollars and _____ cents	LF	100		
18	430-4	<u>18" MES</u> _____ dollars and _____ cents	EA	1		
19	520-1	<u>Concrete Wheel Stop</u> _____ dollars and _____ cents	EA	13		
20	522-1	<u>Concrete Sidewalk</u> _____ dollars and _____ cents	SY	135		
21	527-1	<u>Detectable Warning Surfaces</u> _____ dollars and _____ cents	EA	1		

Bid Item No.	Item No.	Item Description & Unit Price In Words	Unit	Estimated Quantity	Unit Price	Total Amt./ Item
22	700-1	<u>Vehicular Signage</u> _____ dollars and _____ cents	LS	1		
23	710-1	<u>Vehicular Pavement Markings (White)</u> _____ dollars and _____ cents	SF	136		
24	710-2	<u>Vehicular Pavement Markings (Blue)</u> _____ dollars and _____ cents	SF	20		
25	711-1	<u>Thermoplastic, Standard, White, Solid, 24"</u> _____ dollars and _____ cents	LF	30		
26	711-2	<u>Handicap Parking Symbol</u> _____ dollars and _____ cents	EA	1		
27	981-1	<u>Centipede Sod – Commercial Hangar</u> _____ dollars and _____ cents	SY	5,990		
28	02660-1	<u>Potable Water Infrastructure</u> _____ dollars and _____ cents	LS	1		

Bid Item No.	Item No.	Item Description & Unit Price In Words	Unit	Estimated Quantity	Unit Price	Total Amt./ Item
29	02660-2	<u>Concrete Encased 6" Dip Water Line</u> _____dollars and _____cents	LF	190		
30	02730-1	<u>Sanitary Sewer Infrastructure</u> _____dollars and _____cents	LS	1		
31	02730-2	<u>Lift Station</u> _____dollars and _____cents	EA	1		
32	F-162-1	<u>Fencing</u> _____dollars and _____cents	LF	190		
33	F-162-2	<u>5' Pedestrian Gate With Controls</u> _____dollars and _____cents	EA	1		
34	P-620-1	<u>Airfield Pavement Markings With Reflective Media, Yellow</u> _____dollars and _____cents	SF	30		
35	P-620-2	<u>Airfield Pavement Markings Without Reflective Media, Black</u> _____dollars and _____cents	SF	60		

Bid Item No.	Item No.	Item Description & Unit Price In Words	Unit	Estimated Quantity	Unit Price	Total Amt./ Item
36	SP-1	<u>Dumpster Enclosure</u> _____ dollars and _____ cents	EA	1		
37	CH-1	<u>Commercial Hangar, Complete</u> _____ dollars and _____ cents	LS	1		

For all work required to perform the Base Bid work in accordance with the construction drawings, specifications, and other contract documents, including all costs related to the work, and any required permits, taxes, bonds and insurance, the undersigned submits a total bid amount of:

TOTAL BASE BID AMOUNT (in words): _____

_____ Dollars and _____ cents

(\$ _____)
 (amount in numbers)

Note: Total Base Bid amount shall equal the sum of the totals for Bid Item Nos. 1 through 37.

Additive Alternate No. 1 – North T-Hangar

Bid Item No.	Item No.	Item Description & Unit Price In Words	Unit	Estimated Quantity	Unit Price	Total Amt./ Item
1	101-1	<u>Mobilization</u> _____ dollars and _____ cents	LS	1		
2	102-1	<u>Maintenance of Traffic</u> _____ dollars and _____ cents	LS	1		

Bid Item No.	Item No.	Item Description & Unit Price In Words	Unit	Estimated Quantity	Unit Price	Total Amt./ Item
3	104-1	<u>Prevention, Control, Abatement of Erosion and Water Pollution</u> _____ dollars and _____ cents	LS	1		
4	110-1	<u>Complete Concrete and Base Removal</u> _____ dollars and _____ cents	SY	5,710		
5	120-1	<u>Unclassified Excavation and Embankment</u> _____ dollars and _____ cents	LS	1		
6	160-2	<u>12" Stabilized Subgrade</u> _____ dollars and _____ cents	SY	5,310		
7	204-1	<u>8" Graded Aggregate</u> _____ dollars and _____ cents	SY	4,870		
8	346-1	<u>10" PCC Apron</u> _____ dollars and _____ cents	SY	4,425		
9	522-2	<u>Concrete Flume</u> _____ dollars and _____ cents	EA	1		

Bid Item No.	Item No.	Item Description & Unit Price In Words	Unit	Estimated Quantity	Unit Price	Total Amt./ Item
10	981-2	<u>Centipede Sod – North Hangar</u> _____ dollars and _____ cents	SY	125		
11	02660-1	<u>Potable Water Infrastructure</u> _____ dollars and _____ cents	LS	1		
12	P-620-1	<u>Airfield Pavement Markings With Reflective Media, Yellow</u> _____ dollars and _____ cents	SF	600		
13	P-620-2	<u>Airfield Pavement Markings Without Reflective Media, Black</u> _____ dollars and _____ cents	SF	1,200		
14	TH-1	<u>North T-Hangar, Complete</u> _____ dollars and _____ cents	LS	1		

For all work required to perform the Additive Alternate No. 1 work in accordance with the construction drawings, specifications, and other contract documents, including all costs related to the work, and any required permits, taxes, bonds and insurance, the undersigned submits a total bid amount of:

TOTAL ADDITIVE ALTERNATE NO. 1 BID AMOUNT (in words): _____

_____ Dollars and _____ cents

(\$ _____)
 (amount in numbers)

Note: Total Additive Alternate No. 1 amount shall equal the sum of the totals for Bid Item Nos. 1 through 14.

Additive Alternate No. 2 – South T-Hangar

Bid Item No.	Item No.	Item Description & Unit Price In Words	Unit	Estimated Quantity	Unit Price	Total Amt./ Item
1	101-1	<u>Mobilization</u> _____ dollars and _____ cents	LS	1		
2	102-1	<u>Maintenance of Traffic</u> _____ dollars and _____ cents	LS	1		
3	104-1	<u>Prevention, Control, and Abatement of Erosion and Water Pollution</u> _____ dollars and _____ cents	LS	1		
4	110-1	<u>Complete Concrete and Base Removal</u> _____ dollars and _____ cents	SY	5,160		
5	120-1	<u>Unclassified Excavation and Embankment</u> _____ dollars and _____ cents	LS	1		
6	160-2	<u>12" Stabilized Subgrade</u> _____ dollars and _____ cents	SY	4,635		
7	204-1	<u>8" Graded Aggregate</u> _____ dollars and _____ cents	SY	4,250		

Bid Item No.	Item No.	Item Description & Unit Price In Words	Unit	Estimated Quantity	Unit Price	Total Amt./ Item
8	346-1	<u>10" PCC Apron</u> _____ dollars and _____ cents	SY	3,865		
9	981-3	<u>Centipede Sod – South Hangar</u> _____ dollars and _____ cents	SY	85		
10	02660-1	<u>Potable Water Infrastructure</u> _____ dollars and _____ cents	LS	1		
11	P-620-1	<u>Airfield Pavement Markings With Reflective Media, Yellow</u> _____ dollars and _____ cents	SF	330		
12	P-620-2	<u>Airfield Pavement Markings Without Reflective Media, Black</u> _____ dollars and _____ cents	SF	660		
13	TH-2	<u>South T-Hangar, Complete</u> _____ dollars and _____ cents	LS	1		

For all work required to perform the Additive Alternate No. 2 work in accordance with the construction drawings, specifications, and other contract documents, including all costs related to the work, and any required permits, taxes, bonds and insurance, the undersigned submits a total bid amount of:

TOTAL ADDITIVE ALTERNATE NO. 2 BID AMOUNT (in words): _____

_____ Dollars and _____ cents

(\$ _____)
 (amount in numbers)

Note: Total Additive Alternate No. 2 amount shall equal the sum of the totals for Bid Item Nos. 1 through 13.

BID SUMMARY

(A) TOTAL BASE BID: \$ _____
(B) ADDITIVE ALTERNATE No. 1: \$ _____
(C) ADDITIVE ALTERNATE No. 2: \$ _____

The Bidder represents that it has examined the site of the Work and informed itself fully in regard to all conditions pertaining to the place where the work is to be done; that it has examined the plans and specifications for the work and other Contract Documents relative thereto and has read all of the Addenda furnished prior to the opening of the Bids, as acknowledged below; and that it has otherwise fully informed itself regarding the nature, extent, scope and details of the Work to be performed.

If provided with a Notice of Intent to Award the Contract by the Owner, the Bidder shall execute and deliver to the Owner all of the documents required by the Contract Documents, including but not limited to, the Addendum to the Agreement and the Performance and Payment Bonds in the form contained in the Contract Documents, furnish the required evidence of the specified insurance coverages, furnish all necessary permits, license, materials, equipment, machinery, maintenance, tools, apparatus, means of transportation and labor necessary to complete the Work.

Dated and signed this _____ day of _____, 20__.

Name of Bidder

Authorized Signature

Title

Mailing Address

City, State, Zip

(Federal ID No. or SS No.)

BID AFFIDAVIT

The following affidavit must be executed in order that your quotation may be considered.

STATE OF _____

COUNTY OF _____

_____ of lawful age, being first duly sworn, upon his oath deposes and says: That he executed the accompanying Quotation of behalf of the Contractor therein named, and that he had lawful authority so to do, and said Contractor has not directly or indirectly, entered into any agreement, expressed or implied, with any Contractor or Contractors, having to its object the controlling of the price or amount of such quotation or any quotations, the limiting of the Quotation or Contractors, the parceling or farming out to any Contractor or Contractors, to other persons of any part of the contract or any of the subject matter or the Quotations, or of the profits thereof, and that he has not and will not divulge the sealed Quotation to any person whomsoever, except those having a partnership or other financial interest with him in said Quotation or Quotations, until after the sealed Quotation or Quotations are opened.

[signature]

[date]

STATE OF _____ COUNTY OF _____

PERSONALLY APPEARED BEFORE ME, the undersigned authority,

[name of individual signing]

who, after first being sworn by me, affixed his/her signature in the space provided above on this ____ day of _____, 20__.

Subscribed and sworn to before me this _____ day of _____, 20__.

My Commission Expires:

Notary Public

BID BOND

BIDDER (Name and Address):

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

OWNER (Name and Address):

City of Marianna
2895 Jefferson Street
Marianna, Florida 32446

BID:

BID DUE DATE: _____
PROJECT (Brief Description Including Location): Marianna Municipal Airport.

BOND:

BOND NUMBER: _____
DATE: (Not later than Bid Due Date): _____
PENAL SUM: _____

IN WITNESS WHEREOF, Surety and Bidder, intending to be legally bound hereby, subject to the terms printed on the reverse side hereof, do each cause this Bid bond to be duly executed on its behalf by its authorized officer, agent, or representative.

BIDDER

SURETY

Bidder's Name and Corporate Seal

Surety's Name and Corporate Seal

By: _____
Signature and Title

By: _____
Signature and Title
(Attach Power of Attorney)

Attest: _____
Signature and Title

Attest: _____
Signature and Title

- Note:**
- (1) Above addresses are to be used for giving required notice.
 - (2) Any singular reference to Bidder, Surety, Owner or other party shall be considered plural where applicable.

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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.
2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents and Contract 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 and Contract 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 and 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 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 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. Notice 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 deliver, 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 any Bond conflicts with any applicable provision of 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.

10. Provide a financial statement for your company. This should include a balance and income statement for your most recent fiscal year. A certified audit is preferred but not required. Use an insert sheet, if needed. Only three (3) lowest bidders shall submit this information (if requested by Owner) to the Owner within twenty-four (24) hours of the opening of the Bids.

11. State the true, exact, correct and complete name of the partnership, corporation or trade name under which you do business, and the address of the place of business. (If a corporation, state the name of all partners. If a trade name, state the names of the individuals who do business under the trade name.) It is absolutely necessary that information be furnished.

Correct Name of Bidder _____

(a) The business is a _____

(b) The address of principal place of business is:

(c) The names of the corporate officers, or partners, or individuals doing business under a trade name, are as follows:

FORM OF NONCOLLUSION AFFIDAVIT

(This Affidavit is Part of Bid)

STATE OF _____

COUNTY OF _____

_____ Being

first duly sworn, deposes and says that he is

_____ (Sole owner, a partner, president, secretary, etc.) of

_____ the party making the foregoing Proposal or BID that such BID is genuine and not collusive or sham; that said CONTRACTOR has not colluded, conspired, connived, or agreed, directly or indirectly, with any CONTRACTOR or person, to put in a sham BID, or that such other person shall refrain from the project, and has not in any manner, directly or indirectly sought by agreement or collusion, or communication or conference, with any person, to fix the Bid Price of affiant or any other CONTRACTOR, or to fix any overhead, profit or cost element of said Bid Price, or of that of any other CONTRACTOR, or to secure any advantage against OWNER any person interested in the proposed Contract; and that all statements in said Proposal or Bid are true; and further, that such CONTRACTOR has not, directly or indirectly submitted this BID, or the contents thereof, or divulged information or data relative thereto to any association or to any member or agent thereof.

_____ (Contractor)

Sworn to and subscribed before me this ____ day of

_____, 20__.

Notary Public in and for

_____ County,

_____.

My Commission Expires:

_____, 20__.

CERTIFICATION OF NON-SEGREGATED FACILITIES

(Must be completed and submitted with the Bid)

The Bidder certifies that it does not maintain or provide for its employee any segregated facilities at any segregated facilities at any of its establishments, and that it does not permit its employees to perform their services at any location under its control where segregated facilities are maintained. The Bidder certifies further that it will not maintain or provide for its employees segregated facilities at any of its establishments, and that it will not permit its employees to perform their services at any location under its control where segregated facilities are maintained. The Bidder agrees that a breach of this certification is a violation of the equal opportunity clause in this contract. As used in this certification, the term "segregated facilities" means any waiting room, work areas, restrooms and washrooms, restaurants and other eating areas, parking lots, drinking fountains, recreation or entertainment areas, transportation and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on basis of race, color, religion, or national origin, because of habit, local custom, or any other reason. The Bidder agrees that (except where it has obtained identical certification from proposed subcontractors for the specific time period) it will obtain identical certifications from proposed subcontractors prior to the award of subcontracts exceeding \$10,000 which are not exempt from the provisions of the equal opportunity clause, and that it will retain such certification in its files.

(Name of Bidder)

By: _____

Title: _____

Dated: _____

DRUG-FREE WORKPLACE CERTIFICATION

THE BELOW SIGNED BIDDER CERTIFIES that it has implemented a drug-free workplace program. In order to have a drug-free workplace program, a business shall:

1. Publish a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the workplace and specifying the actions that will be taken against employees for violations of such prohibition.
2. Inform employees about the dangers of drug abuse in the workplace, the business's policy of maintaining a drug-free workplace, any available drug counseling, rehabilitation and employee assistance programs, and the penalties that may be imposed upon employees for drug abuse violations.
3. Give each employee engaged in providing the commodities or contractual services that are under bid a copy of the statement specified in subsection 1.
4. In the statement specified in subsection 1, notify the employees that, as a condition of working on the commodities or contractual services that are under bid, the employee will abide by the terms of the statement and will notify the employer of any conviction of, or plea of guilty or nolo contendere to, to any violation of Chapter 893 or of any controlled substance law of the United States or any state, for a violation occurring in the workplace no later than five (5) days after such conviction.
5. Impose a sanction on or require the satisfactory participation in drug abuse assistance or rehabilitation program if such is available in the employee's community, by any employee who is convicted.
6. Make a good faith effort to continue to maintain a drug-free workplace through implementation of this section.

As the person authorized to sign this statement, I certify that this firm complies fully with the above requirements.

DATE: _____

COMPANY: _____

SIGNATURE: _____

ADDRESS: _____

NAME: _____
(Typed or Printed)

TITLE: _____

PHONE #: _____

IDEMNIFICATION AND HOLD HARMLESS

To the fullest extent permitted by law, CONTRACTOR shall indemnify and hold harmless the City of Marianna (OWNER), its officers and employees from liabilities, damages, losses, and costs including but not limited to reasonable attorney fees, to the extent caused by the negligence, recklessness, or intentional wrongful conduct of the CONTRACTOR and other persons employed or utilized by the CONTRACTOR in the performance of this Agreement.

Bidder's Company Name

Authorized Signature - Manual

Physical Address

Authorized Name - Typed

Mailing Address

Title

Phone Number

FAX Number

Cellular Number

After-Hours Number(s)

Date

WORKER'S COMPENSATION AFFIDAVIT

State of _____

County of _____

SS: _____

of _____

being duly sworn, deposes and says that he now carries or that he has applied for a Worker's Compensation Policy to cover the operations, as set forth in the preceding contract, and to comply with the provisions thereof.

Signed: _____

Subscribed and sworn to before me this _____ day of _____, 20 ____

Notary Public

BUY AMERICAN CERTIFICATE

Except for those items listed by the Bidder below or on a separate and clearly identified attachment to this Bid, the Bidder hereby certifies that steel and each manufactured product, is produced in the United States (as defined in Special Provision No. 5) and that components of unknown origin are considered to have been produced or manufactured outside the United States.

PRODUCT COUNTRY OF ORIGIN

(Name of Bidder)

By: _____

Title: _____

Dated: _____

**SWORN STATEMENT UNDER SECTION 287.133 (3) (a),
FLORIDA STATUTES, ON PUBLIC ENTITY CRIMES**

**THIS FORM MUST BE SIGNED AND SWORN IN THE PRESENCE OF A NOTARY PUBLIC OR OTHER OFFICIAL
AUTHORIZED TO ADMINISTER OATHS.**

1. This sworn statement is submitted to _____
[print name of public entity]

by _____
[print individuals name and title]

for _____
[print name of entity submitting sworn statement]

whose business is _____ and (if applicable) its
Federal Employer Identification Number (FEIN) is _____ (If the entity has no FEIN,
include the Social Security Number of the individual signing this sworn statement: _____.)

2. I understand that a "public entity crime" as defined in Paragraph 287.133 (1) (g), Florida Statutes, means a violation of any state or federal law by a person with respect to and directly related to the transaction of business with any public entity or with an agency or political subdivision of any other state or of the United States, including, but not limited to, any bid or contract for goods or services to be provided to any public entity or an agency or political subdivision of any other state or of the United States and involving antitrust, fraud, theft, bribery, collusion, racketeering, conspiracy, or material misrepresentation.

3. I understand that "convicted" or "conviction" as defined in Paragraph 287.133 (1) (b), Florida Statutes, means a finding of guilt or a conviction of a public entity crime, with or without an adjudication of guilt, in any federal or state trial court of record relating to charges brought by indictment or information after July 1, 1989, as a result of a jury verdict, non-jury trial, or entry of a plea of guilty or nolo contendere.

4. I understand that an "affiliate" as defined in Paragraph 287.133 (1) (a), Florida Statutes, means:

A. A predecessor or successor of a person convicted of a public entity crime; or

B. An entity under the control of any natural person who is active in the management of the entity and who has been convicted of a public entity crime. The term "affiliate" includes those officers, directors, executives, partners, shareholders, employees, members and agents who are active in the management of an affiliate. The ownership by one person of shares constituting a controlling interest in another person, or a pooling of equipment or income among persons when not for fair market value under an arm's length agreement, shall be a prima facie case that one person controls another person. A person who knowingly enters into a joint venture with a person who has been convicted of a public entity crime in Florida during the preceding 36 months shall be considered an affiliate.

5. I understand that a "person" as defined in Paragraph 287.133 (1) (e) Florida Statutes, means any natural person or entity organized under the laws of any state or of the United States with the legal power to enter into a binding contract and which bids or applies to bid on contracts for the provision of goods or services let by a public entity, or which otherwise transacts or applies to transact business with a public entity. The term "person" includes those officers, directors, executives, partners, shareholders, and employees, members, and agents who are active in management of an entity.

6. Based on information and belief, the statement which I have marked below is true and in relation to the entity submitting this sworn statement. **[Indicate which statement applies.]**

Neither the entity submitting this sworn statement, nor any of its officers, directors, executives, partners, shareholders, employees, members, or agents who are active in the management of the entity, nor any affiliate of the entity has been charged with and convicted of a public entity crime subsequent to July 1, 1989.

The entity submitting this sworn statement, or one or more of its officers, directors, executives, partners, shareholders, employees, members, or agents who are active in the management of the entity, or an affiliate of the entity has been charged with and convicted of a public entity crime subsequent to July 1, 1989.

The entity submitting this sworn statement, or one or more of its officers, directors, executives, partners, shareholders, employees, members, or agents who are active in the management of the entity, or an affiliate of the entity has been charged with and convicted of a public entity crime subsequent to July 1, 1989. However, there has been a subsequent proceeding before a Hearing Officer of the State of Florida, Division of Administrative Hearings and the Final Order entered by the Hearing Officer determined that it was not in the public interest to place the submitting this sworn statement on the convicted vendor list. **[attach a copy of the final order]**

I UNDERSTAND THAT THE SUBMISSION OF THIS FORM TO THE CONTRACTING OFFICER FOR THE PUBLIC ENTITY IDENTIFIED IN PARAGRAPH 1 (ONE) ABOVE IS FOR THAT PUBLIC ENTITY ONLY AND, THAT THIS FORM IS VALID THROUGH DECEMBER 31 OF THE CALENDAR YEAR IN WHICH IT IS FILED. I ALSO UNDERSTAND THAT I AM REQUIRED TO INFORM THE PUBLIC ENTITY PRIOR TO ENTERING INTO A CONTRACT IN EXCESS OF THE THRESHOLD AMOUNT PROVIDED IN SECTION 287.107, FLORIDA STATUTES FOR CATEGORY TWO ON ANY CHANGE IN THE INFORMATION CONTAINED IN THIS FORM.

[signature]

[date]

STATE OF _____ COUNTY OF _____

PERSONALLY APPEARED BEFORE ME, the undersigned authority,

[name of individual signing]

who, after first being sworn by me, affixed his/her signature in the space provided above on this ____ day of _____, 20__.

Subscribed and sworn to before me this _____ day of _____, 20__.

My Commission Expires:

Notary Public

DISADVANTAGED BUSINESS ENTERPRISE PROGRAM

The following bid condition applies to this U.S. Department of Transportation (DOT) assisted contract. Submission of a bid/proposal by a prospective contractor shall constitute full acceptance of these bid conditions.

1. **DEFINITION** - Disadvantaged Business Enterprise (DBE) as used in this contract shall have the same meaning as defined in 49 CFR Part 26.
2. **POLICY** - It is the policy of DOT that DBE's as defined in 49 CFR Part 26 shall have the maximum opportunity to participate in the performance of contracts and subcontracts financed in whole or in part with Federal funds. Consequently, the DBE requirements of 49 CFR Part 26 apply to this contract.
3. **OBLIGATION** - The contractor agrees to ensure that DBE's as defined in 49 CFR Part 26 have the maximum opportunity to participate in the performance of contracts and subcontracts financed in whole or in part with Federal funds. In this regard, all contractors shall take all necessary and reasonable steps in accordance with 49 CFR Part 26 to ensure that DBE's have the maximum opportunity to compete for and perform contracts. Contractors shall not discriminate on the basis of race, color, national origin, or sex in the award and performance of DOT assisted contracts.
4. **COMPLIANCE** - All bidders, potential contractors, or subcontractors for this DOT assisted contract are hereby notified that failure to carry out the DOT policy and the DBE obligation, as set forth above, shall constitute a breach of contract which may result in termination of the contract or such other remedy as deemed appropriate by the owner.
5. **CONTRACT CLAUSE** - All bidders and potential contractors hereby assure that they will include the above clauses in all subcontracts, which offer further subcontracting opportunities.
6. **CONTRACT AWARD** - Bidders are hereby advised that meeting the DBE subcontract goal or making an acceptable good faith effort to meet said goal are conditions of being awarded this DOT assigned contract.

The owner proposes to award the contract to the lowest responsive and responsible bidder submitting a reasonable bid provided he has met the goal for DBE participation or, if failing to meet the goal, he has made an acceptable good faith effort to meet the established goal for DBE participation. Bidder is advised that the owner reserves the right to reject any or all bids submitted.

7. **DBE PARTICIPATION GOAL** - The attainment of the goal established for this contract is to be measured as a percentage of the total dollar value of the contract. The DBE goal established for this contract is 5 %.
8. **AVAILABLE DBE'S** - The owner has on file a DBE program pending approved by the Federal Aviation Administration. This program contains a listing of DBE's (certified and uncertified). Bidders are encouraged to inspect this list to assist in locating DBE's for the work. Other DBE's may be added to the list in accordance with the owner's approved DBE program. Credit toward the DBE goal will not be counted unless the DBE to be used can be certified by the owner.
9. **CONTRACTOR'S REQUIRED SUBMISSION** - The owner requires the submission of the following information with the bid:

DISADVANTAGED BUSINESS ENTERPRISE PROGRAM

MBE's

<u>MBE Subcontractors Names/Addresses/ Identity</u>	<u>Subcontract Work Item</u>	<u>Dollar Value of Subcontract Work</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____

WBE's

<u>Women Subcontractors Names/Addresses/ Identity</u>	<u>Subcontract Work Item</u>	<u>Dollar Value of Subcontract Work</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____

OSE's

<u>Other Socially and Economically Disadvantaged Subcontractors within the DBE Group Names/Addresses/ Identity</u>	<u>Subcontract Work Item</u>	<u>Dollar Value of Subcontract Work</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____

Total Dollar Value of Subcontract Work	_____
Total Dollar Value of Basic Bid	_____
Total DBE Percent	_____ %

*(Black, Hispanic, Asian American, American Indian, and other economically disadvantaged.)

If the Contractor fails to meet the contract goal established in Section 7 above, the following information must be submitted prior to contract award to assist the owner in determining whether or not the contractor made acceptable good faith efforts to meet the contract goal. This information (when applicable), as well as the DBE information, should be submitted as specified in Section 9 above.

Suggested guidance for use in determining if good faith efforts were made by a contractor are included in 49 CFR Part 26.

A list of the efforts that a contractor may make and the owner may use in making a determination as to the acceptability of a contractor's efforts to meet the goal as included in 49 CFR Part 26 are as follows:

- a. Whether the contractor attended any pre-solicitation or pre-bid meetings that were scheduled by the recipient to inform DBE's of contracting and subcontracting opportunities;
- b. Whether the contractor advertised in general circulation, trade association, and minority-focus media concerning the subcontracting opportunities;
- c. Whether the contractor provided written notice to a reasonable number of specific DBE's that their interest in the contract was being solicited in sufficient time to allow the DBE's to participate effectively;
- d. Whether the contractor followed up initial solicitations of interest by contacting DBE's to determine with certainty whether the DBE's were interested;
- e. Whether the contractor selected portions of work to be performed by DBE's in order to increase the likelihood of meeting the DBE goal (including, where appropriate, breaking down contracts into economically feasible units to facilitate DBE participation);
- f. Whether the contractor provided interested DBE's with adequate information about the plans, specifications, and requirements of the contract;
- g. Whether the contractor negotiated in good faith with interested DBE's, not rejecting DBE's as unqualified without sound reasons based on a thorough investigation of their capabilities.
- h. Whether the contractor made efforts to assist interested DBE's in obtaining bonding, lines of credit, or insurance required by the recipient or contractor;

and

- i. Whether the contractor effectively used the services of available minority community organizations; minority contractors' groups; local and state Federal Minority Business Assistance Offices; and other organizations that provide assistance in the recruitment and placement of DBE's.

NOTE: The nine items set forth above are merely suggested criteria and the owner may specify that you submit information on certain other actions a contractor took to secure DBE participation in an effort to meet the goals. A contractor may also submit to the owner other information on efforts to meet the goals.

10. CONTRACTOR ASSURANCE - The bidder hereby assures that he will meet one of the following as appropriate:

- a. The DBE participation goal as established in the General Conditions.
- b. The DBE participation percentage as shown in Section 9, which was submitted as a condition of contract award.

Agreements between bidder/proposer and a DBE in which the DBE promises not to provide subcontracting quotations to other bidders/proposers are prohibited. The bidder shall make a good faith effort to replace a DBE subcontract that is unable to perform successfully with another DBE subcontractor. Substitution must be coordinated and approved by the owner.

The bidder shall establish and maintain records and submit regular reports, as required, which will identify and assess progress in achieving DBE subcontract goals and other DBE affirmative action efforts.

11. PROMPT PAYMENT - The prime contractor agrees to pay each subcontractor under this prime contract for satisfactory performance of its contract no later than **10** days from the receipt of each payment the prime contractor receives from the owner. The prime contractor agrees further to return retainage payments to each subcontractor within **10** days after the subcontractor's work is satisfactorily completed. Any delay or postponement of payment from the above referenced time frame may occur only for good cause following written approval of the owner. This clause applies to both DBE and non-DBE subcontractors.

DBE CERTIFICATE OF COMPLIANCE FORM

The City of Marianna intends to utilize and implement this program in the awarding of this contract. Disadvantaged Business Enterprises listed by the State of Florida Department of Transportation may be viewed at:

<http://www3b.dot.state.fl.us/EqualOpportunityOfficeBusinessDirectory/CustomSearch.aspx>

This is to certify that I have reviewed the plan, bid evaluation procedure, and DBE directory and will make all reasonable efforts to include DBE Contractors as outlined in pages DBEP 1 through DBEP 4 and in Special Provision No. 9.

Bidder's Signature

Date

Title

Notary Public

INSURANCE REQUIREMENTS

1. The amounts and types of insurance coverage shall conform to the following minimum requirements with the use of Insurance Services Office (ISO) forms and endorsements of their equivalents.
2. The insurance required by this Agreement shall be written for not less than the limits specified herein or required by law, whichever is greater.
3. Coverages shall be maintained without interruption from the date of commencement of the work until the date of completion and acceptance of the project by the Owner or as specified in this Agreement, whichever is longer.
4. Certificates of insurance (3 copies) acceptable to the Owner shall be filed with Owner within ten (10) calendar days after Notice of Awards is received by Contractor/Consultant/Professional. Such certificates shall contain a provision that coverages afforded under the policies will not be canceled or allowed to expire until at least thirty (30) days prior written notice has been given to the owner.
5. All insurance coverages of the Contractor/Consultant/Professional shall be primary to any insurance or self-insurance program carried by the Owner applicable to this Project.
6. The acceptance by Owner of a Certificate of Insurance does not constitute approval or agreement by the Owner that the insurance requirements have been satisfied or that the insurance policy shown on the Certificate of Insurance is in the compliance with the requirements of this Agreement.
7. Contractor/Consultant/Professional shall require each of its subcontractors to procure and maintain, until the completion of the subcontractor's work, insurance of the types and to the limits specified in this Section unless such insurance requirements for the subcontractor are expressly waived in writing by the Owner.
8. Should at any time the Contractor/Consultant/Professional not maintain the insurance coverages required herein, the Owner may terminate the Agreement or at its sole discretion shall be authorized to purchase such coverages and charge the Contractor for such coverages purchased. The Owner shall be under no obligation to purchase such insurance, nor shall it be responsible for the coverages purchased or the insurance company or companies used. The decision of the Owner to purchase such insurance coverages shall in no way be construed to be a waiver of any its rights under the Contract Documents.
9. If the initial, or any subsequently issued Certificate of Insurance expires prior to the completion of the Work or termination of the Agreement, the Contractor/Consultant/Professional shall furnish to the County, in triplicate, renewal or replacement of Certificate(s) of Insurance not later than thirty (30) calendar days prior to the date of their expiration. Failure of the Contractor to provide the County with such renewal certificate(s) shall be considered justification for the County to terminate the Agreement.

10. Owner shall be included as an additional insured on all of Contractor's policies of general liability insurance.
11. Contractor shall comply with each of the following insurance requirements and obligations:
 - (a) Contractor shall obtain comprehensive general liability insurance, including, without limitation, coverage against claims for bodily injury, death, liability, and property damage by reason of, caused by, or resulting from the Work performed by, or any other acts or omissions of, Contractor, any of Contractor's personnel, employees, agents, suppliers, subcontractors, licensees, invitees or trespassers, and anyone claiming by or through the Contractor, and insure Contractor's indemnification obligations to OWNER, with a combined single limit of not less than One Million and 00/100 Dollars (\$1,000,000.00) as the result of any one occurrence. Contractor's comprehensive general liability insurance shall also include premises and operation, contractors, products and completed operations and contractual liability.
 - (b) Contractor shall obtain worker's compensation insurance covering all employees meeting statutory limits in compliance with the applicable state and federal laws. The coverage must include employees' liability with the minimum limit of One Hundred Thousand and 00/100 Dollars (\$100,000.00) for each accident. If exempt, Contractor shall obtain and submit to Owner a "Certificate of Exemption from Florida Workers' Compensation Law" in lieu of such workers' compensation insurance coverage.
 - (c) Contractor shall obtain automobile liability insurance for all automobiles owned, used or hired by Contractor, any of the Contractor's agents, employees, contractors, subcontractors, licensees, invitees or trespassers, and anyone claiming by or through the Contractor, with a combined single limit of not less than One Million and 00/100 Dollars (\$1,000,000.00) as the result of any one occurrence.
 - (d) All of the insurance required under this section shall be obtained by Contractor prior to the commencement of the Work and shall thereafter, until the termination of this Agreement, be continually maintained by Contractor at its sole cost and expense.
 - (e) All insurance coverage of Contractor shall be in addition to, and shall in no way be construed or interpreted to be a limitation of, Contractor's indemnification obligations to Owner. It is expressly agreed that Contractor's policies of insurance required under this section shall be primary over any insurance which Owner may maintain or carry, and that Contractor shall obtain from its insurers an endorsement waiving any other insurance clauses which may be in conflict with this provision, and evidence of such waiver shall be indicated on all insurance policies or certificates of insurance furnished to Owner. Contractor shall be responsible and liable for insuring that all of Contractor's personnel, employees, agents, suppliers, subcontractors, licensees or invitees who perform any of the Work carry and comply the same insurance coverages and requirements required of Contractor under this section.

- (f) Umbrella Liability may be maintained as part of the liability insurance of the Contractor/Consultant /Professional and, if so, such policy shall be excess of the Employers' Liability, Commercial General Liability and Automobile Liability coverages required herein and shall include all coverages on a "following form" basis. The policy shall contain wording to the effect that, in the event of the exhaustion of any underlying limit due to the payment of claims, the Umbrella policy will "drop down" to apply as primary insurance. The General Aggregate limit, if applicable, shall apply separately to this project and the policy shall be so endorsed.

END OF INSURANCE REQUIREMENTS

INSURANCE COMPLIANCE

This form is to be completed and signed by the Contractor and by your insurance agent/carrier certifying that your policy either meets the insurance requirements as specified for this project or that the insurance company has reviewed the bid requirements and certifies that you were quoted any price increase due to required coverage.

CONTRACTOR

I certify that the insurance requirements have been reviewed.

Company Name _____

Address _____

Representative

Name _____

Title _____

Phone Number _____

INSURANCE COMPANY

I certify that the insurance requirements have been reviewed with the above contractor.

Company Name _____

Address _____

Representative

Name _____

Title _____

Phone Number _____

CERTIFICATE AS TO CORPORATE PRINCIPAL

I, _____, certify that I am the Secretary of the Corporation named as Principal in the within bond; that _____ who signed the bond on behalf of the Principal, was then _____ of said Corporation; that I know his/her signature, and his/her signature hereto is genuine; and that said bond was duly signed, sealed, and attested for and in behalf of said Corporation by authority of its governing body.

Secretary (Corporate Seal)

**STATE OF FLORIDA
COUNTY OF**

Before me, a Notary Public, duly commissioned, qualified and acting, personally appeared _____ to me well known, who being my first duly sworn upon oath, says that he/she is the Attorney-in-Fact, for the _____ and that he has been authorized by _____ to execute the foregoing bond on behalf of the Contractor named therein in favor of the City of Marianna.

Subscribed and sworn to before me this ____ day of _____, 20__, A.D.

[Attach Power of Attorney to Original Bid Bond and Financial Statement from Surety Company]

Notary Public
State of Florida-at-Large

My commission Expires:

PERFORMANCE OF WORK BY SUBCONTRACTORS

The CONTRACTOR hereby states that he proposes, if awarded the Contract, to use the following subcontractors on this project: List below all proposed subcontractors and trade specialties. (List only one subcontractor for each item.)

	<u>Items of Work (Describe)</u>	<u>Subcontractors</u>
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

Estimated Total Cost of Items that CONTRACTOR states will be performed by Subcontractor:

(\$ _____)

CONTRACT DOCUMENTS

**BID DOCUMENTS
HANGAR DEVELOPMENTS
MARIANNA MUNICIPAL AIRPORT, MARIANNA, FLORIDA**

**AGREEMENT
BETWEEN OWNER AND CONTRACTOR
FOR CONSTRUCTION CONTRACT (STIPULATED PRICE)**

THIS AGREEMENT is by and between City of Marianna, Florida (“Owner”) and
_____ (“Contractor”).

Owner and Contractor hereby agree as follows:

ARTICLE 1 – WORK

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

Removal and replacement of damaged concrete pavement, crack repair, and removal and replacement of concrete joint sealant.

THE PROJECT

1.02 The Project, of which the Work under the Contract Documents is a part, is generally described as follows: HANGAR DEVELOPMENTS.

ARTICLE 2 – ENGINEER

2.01 The Project has been designed by AVCON INC..

2.02 The Owner has retained AVCON INC. (“Engineer”) 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 the completion of the Work in accordance with the Contract Documents.

ARTICLE 3 – CONTRACT TIMES

3.01 *Time of the Essence*

A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.

3.02 *Contract Times: Days*

A. The Work will be substantially completed within 330 days after the date when the Contract Times commence to run as provided in Paragraph 14.8 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 14.13 of the General Conditions within 360 days after the date when the Contract Times commence to run.

3.03 *Liquidated Damages*

A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial and other losses if the Work is not completed and Milestones not achieved within the times specified in Paragraph 4.02 above, plus any extensions thereof allowed in accordance with the Contract. The parties 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):

1. Substantial Completion: Contractor shall pay Owner \$ 500.00 for each day that expires after the time (as duly adjusted pursuant to the Contract) specified in Paragraph 4.02.A above for Substantial Completion until the Work is substantially complete.
2. Completion of Remaining Work: After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Time (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner \$ 500.00 for each day that expires after such time until the Work is completed and ready for final payment.
3. Liquidated damages for failing to timely attain Substantial Completion and final completion are not additive and will not be imposed concurrently.

3.04 *Special Damages*

- A. In addition to the amount provided for liquidated damages, Contractor shall reimburse Owner (1) for any fines or penalties imposed on Owner as a direct result of the Contractor's failure to attain Substantial Completion according to the Contract Times, and (2) for the actual costs reasonably incurred by Owner for engineering, construction observation, inspection, and administrative services needed after the time specified in Paragraph 4.02 for Substantial Completion (as duly adjusted pursuant to the Contract), until the Work is substantially complete.
- B. After Contractor achieves Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times, Contractor shall reimburse Owner for the actual costs reasonably incurred by Owner for engineering, construction observation, inspection, and administrative services needed after the time specified in Paragraph 4.02 for Work to be completed and ready for final payment (as duly adjusted pursuant to the Contract), until the Work is completed and ready for final payment.

ARTICLE 4 – CONTRACT PRICE

- 4.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents the amounts that follow, subject to adjustment under the Contract:
- A. For all Work, a unit price sum of: \$_____.

ARTICLE 5 – PAYMENT PROCEDURES

5.01 *Submittal and Processing of Payments*

- A. Contractor shall submit Applications for Payment in accordance with Article 14 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.

5.02 *Progress Payments; Retainage*

- A. Owner shall make progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment on or about the 15th day of each month during

performance of the Work as provided in Paragraph 6.02.A.1 below, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in 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 elsewhere in the Contract.

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 Owner may withhold, including but not limited to liquidated damages, in accordance with the Contract
 - a. 90 percent of Work completed (with the balance being retainage). If the Work has been 50 percent completed as determined by Engineer, and if the character and progress of the Work have been satisfactory to Owner and Engineer, then as long as the character and progress of the Work remain satisfactory to Owner and Engineer, there will be no additional retainage; and
 - b. 90 percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage).
- B. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to 100 percent of the Work completed, less retainage.

5.03 *Final Payment*

- A. Upon final completion and acceptance of the Work in accordance with Paragraph 14.12 of the General Conditions, Owner shall pay the remainder of the Contract Price as recommended by Engineer as provided in said Paragraph 14.13.

ARTICLE 6 – INTEREST

6.01 All amounts not paid when due shall bear interest at the rate of 0 percent per annum.

ARTICLE 7 – CONTRACTOR’S REPRESENTATIONS

- 7.01 In order to induce Owner to enter into this Contract, Contractor makes the following representations:
- A. Contractor has examined and carefully studied the Contract Documents, and any data and reference items identified in the Contract Documents.
 - B. Contractor has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, 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. Contractor is familiar with and is satisfied as to all Laws and Regulations that may affect cost, progress, and performance of the Work.
 - D. Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the General Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the General Provisions, especially with respect to Technical Data in such reports and drawings.

- E. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Site-related reports and drawings identified in the Contract 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 Contractor; and (3) Contractor's safety precautions and programs.
- F. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.
- G. Contractor 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 Contract Documents.
- H. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
- I. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
- J. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

ARTICLE 8 – CONTRACT DOCUMENTS

8.01 Contents

- A. The Contract Documents consist of the following:
 - 1. This Agreement (pages 1 to 7, inclusive).
 - 2. Performance bond (pages 1 to 2, inclusive).
 - 3. Payment bond (pages 1 to 2, inclusive).
 - 4. General Conditions (pages 1 to 52, inclusive).
 - 5. General Provisions (pages 1 to 50, inclusive).
 - 6. Specifications as listed in the table of contents of the Project Manual.
 - 7. Drawings (not attached but incorporated by reference) consisting of 46 sheets with each sheet bearing the following general title: MAI HANGAR DEVELOPMENTS.
 - 8. Addenda (numbers 1 to 1, inclusive).
 - 9. Exhibits to this Agreement (enumerated as follows):
 - a. Contractor's Bid (pages to , inclusive).
 - 10. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:
 - a. Notice to Proceed.
 - b. Work Change Directives.

- c. Change Orders.
- d. Field Orders.
- B. The documents listed in Paragraph 9.01.A are attached to this Agreement (except as expressly noted otherwise above).
- C. There are no Contract Documents other than those listed above in this Article 9.
- D. The Contract Documents may only be amended, modified, or supplemented as provided in the General Conditions.

ARTICLE 9 – MISCELLANEOUS

9.01 Terms

- A. Terms used in this Agreement will have the meanings stated in the General Conditions and the General Provisions.

9.02 Assignment of Contract

- A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party hereto of any rights under or interests in the Contract will be binding on another party hereto 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 Documents.

9.03 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.

9.04 Severability

- A. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon Owner and Contractor, who agree that the Contract Documents shall 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.

9.05 Contractor's Certifications

- A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 10.05:
 - 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 or in the Contract execution;
 - 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract 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.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement.

This Agreement will be effective on _____ (which is the Effective Date of the Contract).

OWNER:

CONTRACTOR:

City of Marianna, Florida _____

By: _____

By: _____

Title: _____

Title: _____

(If Contractor is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest: _____

Attest: _____

Title: _____

Title: _____

Address for giving notices:

Address for giving notices:

License No.: _____
(where applicable)

(If Owner is a corporation, attach evidence of authority to sign. If Owner is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of this Agreement.)

NOTE TO USER: Use in those states or other jurisdictions where applicable or required.

PERFORMANCE BOND

KNOW ALL MEN by these presents; That we (1) _____
_____ a (2) _____
hereinafter called "Principal" and (3) _____
of _____, State of _____, hereinafter called the "Surety",
are held and firmly bound unto (4) _____ of _____
_____, hereinafter called "OWNER", in the penal sum of _____
_____ dollars (\$ _____) in lawful money
of the United States for the payment of which sum well and truly to be made, we bind ourselves, our
heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas, the Principal entered into a certain contract
with the Owner, dated the ____ day of _____, 20____, a copy of which is hereto attached and
make a part hereof for the construction of:

MARIANNA MUNICIPAL AIRPORT- HANGAR DEVELOPMENTS

NOW, THEREFORE, if the Principal shall well, truly and faithfully perform its duties, all the
undertakings, covenants, terms, conditions, and agreements of said contract during the original term
thereof, and any extensions thereof which may be granted by the Owner, with or without notice to
the Surety, and if he shall satisfy all claims and demands incurred under such contract, and shall fully
indemnify and save harmless the Owner from all costs and damages which it may suffer by reason of
failure to do so, and shall reimburse and repay the Owner all outlay and expense which the Owner
may incur in making good any default, then this obligation shall be void; otherwise to remain in full
force and effect.

PROVIDED, FURTHER, that the said 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 to be
performed thereunder or the Specifications accompanying the same shall in any way affect its
obligations on this bond, and it does not hereby waive notice of any such change, extension of time,
alteration or addition to the terms of the contract or to the work or to the Specifications.

PROVIDED, FURTHER, that no final settlement between the Owner and the Contractor shall abridge
the right of any beneficiary hereunder, whose claim may be unsatisfied.

IN WITNESS WHEREOF, this instrument is executed in six (6) counterparts, each one of which shall be deemed an original, this the _____ day of _____, 20____.

ATTEST:

Principal

(Principal) Secretary

By: _____

Witness as to Surety

Address

Address

SEAL:

ATTEST:

Surety

(Surety) Secretary

Attorney-in-Fact

Witness as to Surety

Address

Address

SEAL:

Date of bond must not be prior to date of Contract

1. Correct name of Contractor.
2. A Corporation, A Partnership or an Individual as case may be.
3. Correct name of Surety.
4. Correct name of Owner.
5. If Contractor is Partnership, all partners should execute bond.

PAYMENT BOND

KNOW ALL MEN by these presents; That we (1) _____
_____ a (2) _____
hereinafter called "Principal" and (3) _____
of _____, State of _____, hereinafter call the
"Surety", are held and firmly bound unto (4) _____
of _____ State of Florida _____, hereinafter called "OWNER", in the penal sum of _____
_____ dollars (\$ _____) in lawful money
of the United States for the payment of which sum well and truly to be made, we bind ourselves, our heirs,
executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that Whereas, the Principal entered into a certain contract
with the Owner, dated the _____ day of _____, 20____, a copy of which is
hereto attached and make a part hereof for the construction of:

MARIANNA MUNICIPAL AIRPORT- HANGAR DEVELOPMENTS

THEREFORE, if the Principal shall promptly make payments to all persons, firms, subcontractors, and
corporations furnishing materials for or performing labor in the prosecution of the work provided for in
such contract, and any authorized extension or modification thereof, including all amounts due for
materials, lubricants, oil, gasoline, coal and coke, repairs on machinery, equipment and tools, consumed
or used in connection with the construction of such work, and all insurance premiums on said work, and
for all labor, performed in such work, whether by subcontractor or otherwise, then this obligation shall
be void; otherwise to remain in full force and effect.

PROVIDED, FURTHER, that the said 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 to
be in any wise affect its obligation on this bond, and it does hereby waive notice of any such
changes, extension of time, alteration or addition to the terms of the contractor or to the work or
to the Specifications.

PROVIDED, FURTHER, that no final settlement between the Owner and the Contractor shall
abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.

IN WITNESS WHEREOF, this instrument is executed in six (6) counterparts, each one of which shall be deemed an original, this the _____ day of _____, 20____.

ATTEST:

Principal

(Principal) Secretary

By: _____

Witness as to Surety

Address

Address

SEAL:

ATTEST:

Surety

(Surety) Secretary

Attorney-in-Fact

Witness as to Surety

Address

Address

SEAL:

CONTRACTOR'S RELEASE OF LIENS

STATE OF: _____

COUNTY OF: _____

Before me, the undersigned Notary Public in and for the said County and State personally appeared _____, representing the Contractor _____, who being duly sworn according to law deposes and says that all labor, materials, and outstanding claims and indebtedness of whatever nature arising out of the performance of the Contract with _____, the Owner, for _____, Contract No. , have been paid in full and that for the final payment in the amount of \$ _____, the Contractor releases and discharges the Owner and his authorized representatives from any liens or claims or any nature because of or arising from this Contract and/or its performance, which it has had, has or may have in the future.

By: _____

Sworn to and subscribed before me this

_____ day of _____

(Notary Public)

My Commission Expires: _____

CONTRACTOR'S PARTIAL RELEASE OF LIENS WAIVER

In consideration of the payment by City of Marianna for the amount of \$_____ and other payments heretofore, the receipt whereof is acknowledged, that undersigned does hereby wave the right to claim and/or file any lien for work or labor done or materials furnished, to and through _____ against property and improvements known as HANGAR DEVELOPMENTS and acknowledge full and adequate payment for all work, labor, materials, and services through the date above. (Note: The date should coincide with date of Subcontractor's estimate for progress payments whenever possible.)

IN WITNESS WHEREOF, this lien waiver has been duly executed on this _____ day of _____, 20__.

Contractor:

Printed Name

Signature

Title

STATE OF: Florida
COUNTY OF: _____

BEFORE ME, the undersigned authority, personally appeared _____, who being by me first duly sworn, deposes and says that he/she has authority to execute the forgoing and that the facts stated in the forgoing are true and correct.

Sworn to and subscribed before me this _____ day of _____, 20__.

(Notary Public)

My Commission Expires: _____

CERTIFICATE OF ATTORNEY – OWNER

I, the undersigned,

the duly authorized and acting legal representative of

CITY OF MARIANNA

do hereby certify that I have examined the foregoing contract and the Surety Bond attached thereto and the manner of execution thereof, and that I am of the opinion that each of the aforesaid agreements has been executed by the proper representatives, and that said representatives have respectively the full power and authority to execute said agreements on behalf of the respective parties named therein, and that the foregoing agreements constitute valid and legally binding obligations upon the parties executing the same in accordance with the terms, conditions and provisions thereof.

Signed: _____

Title: _____

Date: _____

GENERAL CONDITIONS

**BID DOCUMENTS
HANGAR DEVELOPMENTS
MARIANNA MUNICIPAL AIRPORT, MARIANNA, FLORIDA**

GENERAL CONDITIONS

ARTICLE 1 – DEFINITIONS

Wherever used in these General Conditions or in the other Contract Documents the following terms have the meanings indicated which are applicable to both the singular and plural thereof:

- 1.0.1 *AASHTO – The American Association of State Highway and Transportation Officials, the successor association AASHTO.*
- 1.0.2 *ACCESS ROAD – The right-of-way, the roadway and all improvements constructed thereon connecting the airport to a public highway.*
- 1.1. **Addenda** – Written or graphic instruments issued prior to the opening of Bids which clarify, correct or change the Project Requirements or the Contract Documents.
 - 1.1.1 *ADVERTISEMENT – A public announcement, as required by local law, inviting bids for work to be performed and materials to be furnished.*
- 1.2. **Agreement** – The written contract between Owner and Contractor covering the Work to be performed; other Contract Documents are attached to the Agreement and made a part thereof as provided therein.
 - 1.2.1 *AIP – The Airport Improvement Program, a grant-in-aid program, administered by the Federal Aviation Administration.*
 - 1.2.2 *AIR OPERATIONS AREA – For the purpose of these specifications, the term air operations area shall mean any area of the airport used or intended to be used for the landing, takeoff, or surface maneuvering of aircraft. An air operation area shall include such paved or unpaved areas that are used or intended to be used for the unobstructed movement of aircraft in addition to its associated runway, taxiway, or apron.*
 - 1.2.3 *AIRPORT – Airport means the area of land or water which is used or intended to be used for the landing and takeoff of aircraft, and includes its buildings and facilities, if any.*
- 1.3. **Application for Payment** – The form accepted by Engineer which is to be used by Contractor in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
- 1.4. **Asbestos** – Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.
 - 1.4.1 *ASTM – The American Society for Testing and Materials.*
 - 1.4.2 *AWARD – The acceptance, by the Owner, of the successful contractor's proposal.*
- 1.5. **Bid** – The offer or proposal of the contractor submitted on the prescribed form setting forth the prices for the Work to be performed.

- 1.5.1 *CONTRACTOR* – Any individual, partnership, firm, or corporation, acting directly or through a duly authorized representative, who submits a proposal for the work contemplated.
- 1.6. **Project Documents** – The advertisement or invitation to Bid, instructions to contractors, the Bid Form, and the proposed Contract Documents (including all Addenda issued prior to receipt of Bids).
- 1.7. **Project Requirements** – The advertisement or invitation to Bid, instructions to contractors, and the Bid Form.
- 1.7.1 *BUILDING AREA* – An area on the airport to be used, considered, or intended to be used for airport buildings, or other facilities or rights-of-way together with all airport buildings and facilities located thereon.
- 1.8. **Bonds** – Performance and Payment bonds and other instruments of security.
- 1.8.1 *CALENDAR DAY* – Every day shown on the calendar.
- 1.8.2 *CERTIFICATES OF COMPLIANCES* – Written statements by the manufacturer stating the material furnished is in conformance with the Specifications.
- 1.9. **Change Order** – A document recommended by Engineer, 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, issued on or after the Effective Date of the Agreement. *The work covered by a change order shall be within the scope of the contract.*
- 1.10. **Contract Documents** – The Agreement, Addenda (which pertain to the Contract Documents), Contractor's Bid (including documentation accompanying the Bid and any post Bid documentation submitted prior to the Notice of Award) when attached as an exhibit to the Agreement, the Notice to Proceed, the Bonds, these General Conditions, the Supplementary Conditions, the Specifications and the Drawings as the same are more specifically identified in the Agreement, together with all Written Amendments, Change Orders, Work Change Directives, Field Orders and Engineer's written interpretations and clarifications issued pursuant to paragraphs 3.5, 3.6.1, and 3.6.3 on or after the Effective Date of the Agreement. Shop Drawing submittals approved pursuant to paragraphs 6.26 and 6.27 and the reports and drawings referred to in paragraphs 4.2.1.1 and 4.2.2.2 are not Contract Documents.
- 1.11. **Contract Price** – The money payable by Owner to Contractor for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of paragraph 11.9.1 in the case of Unit Price Work).
- 1.12. **Contract Times** – The numbers of days or the dates stated in the Agreement: (i) to achieve Substantial Completion, and (ii) to complete the Work so that it is ready for final payment as evidenced by Engineer's written recommendation of final payment in accordance with paragraph 14.13.
- 1.12.1 *CONTRACT ITEM (PAY ITEM)* – A specific unit of work for which a price is provided in the Contract.
- 1.13. **Contractor** – The person, firm or corporation with whom Owner has entered into the Agreement.

- 1.14. **Defective** – An adjective which when modifying the word Work refers to Work that is unsatisfactory, faulty or deficient, in that it does not conform to the Contract Documents, or does not meet the requirements of any inspection, reference standard, test or approval referred to in the Contract Documents, or 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 14.8 or 14.10).
- 1.14.1 *DRAINAGE SYSTEM* – *The system of pipes, ditches, and structures by which surface or subsurface waters are collected and conducted from the airport area.*
- 1.15. **Drawings** – The drawings which show the scope, extent, and character of the Work to be furnished and performed by Contractor and which have been prepared or approved by Engineer and are referred to in the Contract Documents. Shop drawings are not Drawings as so defined.
- 1.16. **Effective Date of the Agreement** – The date indicated in the Agreement on which it becomes effective, but if no such date is indicated it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.
- 1.17. **Engineer** – The person, firm, or corporation named as such in the Agreement.
- 1.18. **Engineer's Consultant** – A person, firm, or corporation having a contract with Engineer to furnish services as Engineer's independent professional associate or consultant with respect to the Project and who is identified as such in the Supplementary Conditions. *The following list of independent professional associates and consultants are considered the Engineer's consultant for this Construction Contract: AVCON, Inc.*
- 1.18.1 *EQUIPMENT* – *All machinery, together with the necessary supplies for upkeep and maintenance, and also all tools and apparatus necessary for the proper construction and acceptable completion of the work.*
- 1.18.2 *EXTRA WORK* – *An item of work not provided for in the awarded contract as previously modified by change order or supplemental agreement, but which if found by the Engineer to be necessary to complete the work within the intended scope of the contract as previously modified.*
- 1.18.3 *FAA* – *The Federal Aviation Administration of the U.S. Department of Transportation. When used to designate a person, FAA shall mean the Administrator or his duly authorized representative.*
- 1.18.4 *FEDERAL SPECIFICATIONS* – *The Federal Specifications and Standards, and supplements, amendments, and indices thereto are prepared and issued by the General Services Administration of the Federal Government. They may be obtained from the Specifications Activity, Printed Materials Supply Division, Building 197, Naval Weapons Plant, Washington, D.C. 20407.*
- 1.19. **Field Order** – A written order issued by Engineer which orders minor changes in the Work in accordance with paragraph 9.5 but which does not involve a change in the Contract Price or the Contract Times.
- 1.20. **General Requirements** – Sections of Division 1 of the Specifications.

- 1.21. **Hazardous Waste** – The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.
- 1.22. *1.21.1 INSPECTOR – An authorized representative of the Engineer assigned to make all necessary inspections and/or tests of the work performed or being performed, or of the materials furnished or being furnished by the Contractor.*
- 1.21.2 INTENTION OF TERMS – Whenever, in these specifications or on the plans, the words, "directed," "required," "permitted," "ordered," "designated," "prescribed," or words of the like import are used, it shall be understood that the direction, requirement, permission, order, designation, or prescription of the Engineer is intended; and similarly, the words "approved," "acceptable," "Satisfactory," or words of like import, shall mean approved by, or acceptable to, or satisfactory to the Engineer, subject in each case to the final determination of the Owner.*
- 1.21.3 LABORATORY – The official testing laboratories of the Owner or such other laboratories as may be designated by the Engineer.*
- 1.22. **Laws and Regulations; Laws or Regulations** – Any and all applicable laws, rules, regulations, ordinances, codes and orders of any and all governmental bodies, agencies, authorities and courts having jurisdiction.
- 1.23. **Liens** – Liens, charges, security interests, or encumbrances upon real property or personal property.
- 1.23.1 LIGHTING – A system of fixtures providing or controlling the light sources used on or near the airport or within the airport buildings. The field lighting includes all luminous signals, markers, floodlights, and illuminating devices used on or near the airport or to aid in the operation of aircraft landing at, taking off from, or taxiing on the airport surface.*
- 1.23.2 MAJOR AND MINOR CONTRACT ITEMS – A major contract item shall be any item that is listed in the proposal, the total cost of which is equal to or greater than 25 percent of the total amount of the award contract. All other items shall be considered minor contract items.*
- 1.23.3 MATERIALS – Any substance specified for use in the construction of the Contract work.*
- 1.23.4 MIL SPECIFICATIONS – The Military Specifications and Standard, and indices thereto, that are prepared and issued by the Department of Defense.*
- 1.24. **Milestone** – A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.
- 1.25. **Notice of Award** – The written notice by Owner to the apparent successful contractor stating that upon compliance by the apparent successful contractor with the conditions precedent enumerated therein, within the time specified, Owner will sign and deliver the Agreement.
- 1.26. **Notice to Proceed** – A written notice given by Owner to Contractor (with a copy to Engineer) fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform Contractor's obligations under the Contract Documents.
- 1.26.1 FDOT – The Florida State Department of Transportation. When used to designate a person, FDOT shall mean the commissioner or his duly authorized representative.*

- 1.27. **Owner** – The public body or authority, corporation, association, firm, or person with whom Contractor has entered into the Agreement and for whom the Work is to be provided.
- 1.28. **Partial Utilization** – Use by Owner of a substantially completed part of the Work for the purpose for which it is intended (or a related purpose) prior to Substantial Completion of all the Work.
- 1.28.1 *PAVEMENT* – *The combined surface course, base course, and subbase course, if any, considered as a single unit.*
- 1.28.2 *PAYMENT BOND* – *The approved form of security furnished by the Contractor and his/her surety as a guaranty that he will pay in full all bills and accounts for materials and labor used in the construction of the work.*
- 1.29. **PCBs** – Polychlorinated biphenyls.
- 1.29.1 *PERFORMANCE BOND* – *The approved form of security furnished by the Contractor and his/her surety as a guaranty that the Contractor will complete the work in accordance with the terms of the contract.*
- 1.30. **Petroleum** – Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Wastes and crude oils.
- 1.30.1 *PLANS* – *The official drawings or exact reproductions which show the location, character, dimensions, and details of the airport and the work to be done and which are to be considered as a part of the contract, supplementary to the specifications.*
- 1.31. **Project** – The total construction of which the Work to be provided under the Contract Documents may be the whole, or a part as indicated elsewhere in the Contract Documents.
- 1.31.1 *PROPOSAL* – *(See Bid).*
- 1.32. **Radioactive Material** – Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.
- 1.33. **Resident Project Representative** - The authorized representative of Engineer who may be assigned to the site or any part thereof.
- 1.33.1 *RUNWAY* – *The area on the airport prepared for the landing and takeoff of aircraft.*
- 1.34. **Samples** – Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.
- 1.35. **Shop Drawings** – All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.

- 1.35.1 **SPECIAL PROVISIONS** – The specific clauses setting forth conditions or requirements peculiar to the project under consideration, covering work or materials involved in the proposal and estimate, which are not thoroughly or satisfactorily stipulated in these specifications.
- 1.36. **Specifications** – Those portions of the Contract Documents consisting of written technical descriptions of materials, equipment, construction systems, standards, and workmanship as applied to the Work and certain administrative details applicable thereto.
- 1.36.1 *SPONSOR* – For AIP Contracts, the term Sponsor shall have the meaning as the term Owner.
- 1.36.2 *STRUCTURES* – Airport facilities such as bridges; culverts; catch basins; inlets; retaining walls; cribbing; storm and sanitary sewer lines; water lines; underdrains; electrical ducts, manholes, handholes, lighting fixtures and bases; transformers; flexible and rigid pavements; navigational aids; buildings; vaults; and, other manmade features of the airport that may be encountered in the work and not otherwise classified herein.
- 1.37. **Subcontractor** – An individual, firm, or corporation having a direct contract with Contractor or with any other Subcontractor for performance of a part of the Work at the site.
- 1.37.1 *SUBGRADE* – The soil which forms the pavement foundation.
- 1.37.2 *SUPERINTENDENT* – The Contractor's executive representative who is present on the work during progress, authorized to receive and fulfill instruction from the Engineer, and who shall supervise and direct the construction.
- 1.38. **Substantial Completion** – The Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer as evidenced by Engineer's definitive certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents, so that the Work (or specified part) can be utilized for the purposes for which it is intended; or if no such certificate is issued, when the Work is complete and ready for final payment as evidenced by Engineer's written recommendation of final payment in accordance with paragraph 14.13. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.
- 1.38.1 *SUPPLEMENTAL AGREEMENT* – A written agreement between the Contractor and the Owner covering: (1) work that would increase or decrease the total amount of the awarded contract, or any major contract item, by more than 25 percent, such increased or decreased work being within the scope of the originally awarded contract; or (2) work that is not within the scope of the originally awarded contract.
- 1.39. **Supplementary Conditions** – The part of the Contract Documents which amends or supplements these General Conditions.
- 1.40. **Supplier** – A manufacturer, fabricator, supplier, distributor, materialman, or vendor having direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or any Subcontractor.
- 1.40.1 *SURETY* – The corporation, partnership, or individual, other than the Contractor, executing payment or performance bonds which are furnished to the Owner by the Contractor.

- 1.40.2 **TAXIWAY** – *For the purpose of this document, the term taxiway means the portion of the air operations area of an airport that has been designated by competent airport authority for movement of aircraft to and from the airport's runways or aircraft parking areas.*
- 1.41. **Underground Facilities** – All pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities which have been installed underground to furnish any of the following services or materials: electricity, gases, steam, liquid petroleum products, telephone, or other communications, cable television, sewage and drainage removal, traffic or other control systems or water.
- 1.42. **Unit Price Work** – Work to be paid for on the basis of unit prices.
- 1.43. **Work** – The entire completed construction or the various separately identifiable parts thereof required to be furnished under the Contract Documents. Work includes and is the result of performing or furnishing labor and furnishings and incorporating materials and equipment into the construction, and performing or furnishing services and furnishing documents, all as required by the Contract Documents.
- 1.44 **Work Change Directive** - A written directive to Contractor, issued on or after the Effective Date of the Agreement and signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen physical conditions under which the Work is to be performed as provided in paragraph 4.2 or 4.3 or to emergencies under paragraph 6.23. A Work Change Directive will not change the Contract Price or the Contract Times, but is evidence that the parties expect that the change directed or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times as provided in paragraph 10.2.
- 1.44.1 **WORKING DAY** – *A working day shall be any day other than a legal holiday, Saturday, or Sunday on which the normal working forces of the Contractor may proceed with regular work for at least 6 hours toward completion of the Contract. Unless work is suspended for causes beyond the Contractor's control, Saturdays, Sundays and holidays on which the Contractor's forces engage in regular work, requiring the presence of an inspector, will be considered as working days.*
- 1.44.2 **WORK PERIOD** – *A work period shall consist of any designated block of time on which the normal working forces of the Contractor may proceed with regular work for at least 5 hours toward completion of the contract. Unless work is suspended for causes beyond the Contractor's control, work occurring on any day, regardless of it being a weekend or holiday, which requires an Inspector, will be considered a work period. Work periods are limited to between 7:00 a.m. and 5:00 p.m. local time Monday through Friday. Weekend work will not be permitted unless contractor obtains written permission from Owner.*
- 1.45. **Written Amendment** – A written amendment of the Contract Documents, signed by Owner and Contractor on or after the Effective Date of the Agreement and normally dealing with the nonengineering or nontechnical rather than strictly construction-related aspects of the Contract Documents.

ARTICLE 2 – PRELIMINARY MATTERS

Delivery of Bonds:

- 2.1. When Contractor delivers the executed Agreements to Owner, Contractor shall also deliver to Owner such Bonds as Contractor may be required to furnish in accordance with paragraph 5.1.

Copies of Documents:

- 2.2. Owner shall furnish to Contractor up to five copies (unless otherwise specified in the Supplementary Conditions) of the Contract Documents as are reasonably necessary for the execution of the Work. Additional copies will be furnished, upon request, at the cost of reproduction.

Commencement of Contract Times; Notice to Proceed:

- 2.3. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Agreement, 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 thirty days after the Effective Date of the Agreement. In no event will the Contract Time commence to run later than the *one hundred twentieth (120th)* day after the day of Bid opening or the *ninetieth (90th)* day after the Effective Date of the Agreement, whichever date is earlier.

Starting the Work:

- 2.4. Contractor shall start to perform the Work on the date when the Contract Times commence to run, but no Work shall be done at the site prior to the date on which the Contract Times commence to run.

Before Starting Construction:

- 2.5. Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures shown thereon and all applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity or discrepancy which Contractor may discover and shall obtain a written interpretation or clarification from Engineer before proceeding with any Work affected thereby; however, 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 knew or reasonably should have known thereof.
- 2.6. Within ten days after the Construction Notice to Proceed contractor shall submit to Engineer for review:
 - 2.6.1. 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 Documents;
 - 2.6.2. a preliminary schedule of Shop Drawings and Sample submittals which will list each required submittal and the times for submitting, reviewing and processing such submittal;
 - 2.6.3. a preliminary schedule of values for all of the Work which will include quantities and prices of items aggregating the Contract Price and will subdivide the Work into component parts in sufficient detail to serve as the basis for progress payments during construction. Such prices will include and appropriate amount of overhead and profit applicable to each item of Work.

2.7. Before any Work at the site is started, Contractor and Owner shall each deliver to the other, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which Contractor and Owner respectively are required to purchase and maintain in accordance with paragraphs 5.4, 5.6, and 5.7.

Preconstruction Conference:

2.8. Within twenty (20) days prior to *Construction Notice to Proceed*, but before any Work at the site is started, a conference attended by 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 2.6, procedures for handling Shop Drawings, and other submittals, processing Applications for Payment and maintaining required records.

Initially Acceptable Schedules:

2.9. Unless otherwise provided in the Contract Documents, at least ten days before submission of the first Application for Payment a conference attended by Contractor, Engineer, and others as appropriate will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with paragraph 2.6. Contractor shall have an additional ten days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until the schedules are submitted to and acceptable to Engineer as provided below. The progress schedule will be acceptable to Engineer as providing an orderly progression of the Work to completion within any specified Milestones and the Contract Times, but such acceptance will neither impose on Engineer responsibility for the sequencing, scheduling, or progress of Work nor interfere with or relieve Contractor from Contractor's full responsibility therefore, Contractor's schedule of Shop Drawing and Sample submissions will be acceptable to Engineer as providing a workable arrangement for reviewing and processing the required submittals. Contractor's schedule of values will be acceptable to Engineer as to form and substance.

ARTICLE 3 – CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

Intent:

3.1. The Contract Documents comprise the entire agreement between Owner and Contractor concerning the Work. The Contract Documents are complementary: what is called for by one is as binding as if called for by all. The Contract Documents will be construed in accordance with the law of the place of the Project.

3.2. 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. Any Work, materials, or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result will be furnished and performed whether or not specifically called for. When words or phrases, which have a well-known technical or construction industry or trade meaning are used to describe Work, materials, or equipment, such words or phrases shall be interpreted in accordance with the meaning. Clarifications and interpretations of the Contract Documents shall be issued by Engineer as provided in paragraph 9.4.

3.3. Reference to Standards and Specifications of Technical Societies: Reporting and Resolving Discrepancies:

3.3.1. Reference to standards, specifications, manuals or codes of any technical society, organization, or association, or to the Laws or Regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard, specification, manual, code or Laws or

Regulations in effect at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

3.3.2. If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents or between the Contract Documents and any provision of any such Law or Regulation applicable to the performance of the Work or of any such standard, specification, manual, or code or of any instruction of any Supplier referred to in paragraph 6.5., Contractor shall report it to Engineer in writing at once, and, Contractor shall not proceed with the Work affected thereby (except in an emergency as authorized by paragraph 6.23) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in paragraph 3.5 or 3.6; provide, however, that Contractor shall not be liable to Owner or Engineer for failure to report any such conflict, error, ambiguity or discrepancy unless Contractor knew or reasonably should have known thereof.

3.3.3. Except as otherwise specifically stated in the Contract Documents or as may be provided by amendment or supplement thereto issued by one of the methods indicated in paragraph 3.5 or 3.6, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:

3.3.3.1. the provisions of any such standard, specification, manual, code, or instruction (whether or not specifically incorporated by reference in the Contract Documents): or

3.3.3.2. the provisions of any such 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).

No provision of any such standard, specification, manual, code, or instruction shall be effective to change the duties and responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees from those set forth in the Contract Documents, nor shall it be effective to assign to Owner, Engineer, or any of Engineer's Consultants, agents, or employees any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of paragraph 9.13 or any other provision of the Contract Documents.

3.3.4. Whenever the plans or specifications are in conflict, resolution of such conflict shall be in the following order of precedence subject to agreement by Engineer:

- Contract Agreement
- Addenda, with those of later date having precedence over those of earlier dates
- Bid Documents
- Supplementary Conditions
- General Conditions
- Construction Drawings
- Technical Specifications
- FAA General Provisions
- Florida DOT Standard Specifications

In case of our inconsistency within the Contract Drawings, the order of procedure is as follows:
Schedules

Specific Details
Typical Details
Construction Drawings

3.4. Whenever in the Contract Documents the terms "as ordered," "as directed," "as required," "as allowed," "as approved" or terms of like effect or import are used, or the adjectives "reasonable," "suitable," "acceptable," "proper," or "satisfactory" or adjectives of like effect or import are used to describe a requirement, direction, review or judgment of Engineer as to the Work, it is intended that such requirement, direction, review, or judgment will be solely to evaluate, in general, the completed Work for compliance with the requirements of and information in the Contract Documents and conformance with the design concept of the completed 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 shall not be effective to assign to Engineer any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of paragraph 9.13 or any other provision of the Contract Documents.

Amending and Supplementing Contract Documents:

3.5. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof in one or more of the following ways:

- 3.5.1. a formal Written Amendment.
- 3.5.2. a Change Order (pursuant to paragraph 10.4) or
- 3.5.3. a Work Change Directive (pursuant to paragraph 10.1).

3.6. In addition, the requirements of the Contract Documents may be supplemented and minor variations, and deviations of the Work may be authorized, in one or more of the following ways:

- 3.6.1. a Field Order (pursuant to paragraph 9.5).
- 3.6.2. Engineer's approval of a Shop Drawing or Sample (pursuant to paragraphs 6.26 and 6.27), or
- 3.6.3. Engineer's written interpretation or clarification (pursuant to paragraph 9.4).

Reuse of Documents:

3.7. Contractor and any Subcontractor or Supplier or other person or organization performing or furnishing any of the Work under a direct or indirect contract with Owner (i) shall not 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 Engineer's Consultant, and (ii) shall not reuse any of such Drawings, Specifications, other documents, or copies on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer.

**ARTICLE 4 – AVAILABILITY OF LANDS: SUBSURFACE AND PHYSICAL CONDITIONS;
REFERENCE POINTS**

Availability of Lands:

4.1. Owner shall furnish, as indicated in the Contract Documents, the lands upon which the Work is to be performed, rights-of-way and easements for access thereto, and such other lands which are designated for the use of Contractor. Upon reasonable written request, Owner shall furnish Contractor with a correct statement of record legal title and legal description of the lands upon which the Work is to be performed and Owner's interest therein as necessary for giving notice of or filing a mechanic's lien against such lands in accordance with applicable Laws and Regulations. Owner shall identify any encumbrances or restrictions not of general application but specifically related to use of lands so furnished with which Contractor will have to comply in performing the Work. Easements for permanent structures or permanent in existing facilities will be obtained and paid for by Owner, unless otherwise provided in the Contract Documents. If Contractor and Owner are unable to agree on entitlement to or the amount or extent of any adjustments in the Contract Price or the Contract Times as a result of any delay in Owner's furnishing these lands, rights-of-way or easements. Contractor may make a claim therefore as provided in Articles 11 and 12. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.2. SubSurface and Physical Conditions:

4.2.1. **Reports and Drawings:** Reference is made to the *Information Available to Contractors* for identification of:

4.2.1.1. **Subsurface Conditions:** Those reports of explorations and tests of subsurface conditions at or contiguous to the site that have been utilized by Engineer in preparing the Contract Documents; and

4.2.1.2. **Physical Conditions:** Those drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the site (except Underground Facilities) that have been utilized by Engineer in preparing the Contract Documents.

4.2.2. **Limited Reliance by Contractor Authorized; Technical Data:** Contractor may rely upon the general accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the *Information Available to Contractors*. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner, Engineer, or any of Engineer's Consultants with respect to:

4.2.2.1. 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, or

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

4.2.2.3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such data, interpretations, opinions, or information.

4.2.3. **Notice of Differing Subsurface or Physical Conditions:** If Contractor believes that any subsurface or physical condition at or contiguous to the site that is uncovered or revealed either:

4.2.3.1. is of such a nature as to establish that any "technical data" on which Contractor is entitled to rely as provided in paragraphs 4.2.1 and 4.2.2 is materially inaccurate, or

4.2.3.2. is of such a nature as to require a change in the Contract Documents, or

4.2.3.3. differs materially from that shown or indicated in the Contract Documents, or

4.2.3.4. 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 conditions affected thereby or performing any Work in connection therewith (except in an emergency as permitted by paragraph 6.23), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such conditions or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

4.2.4. **Engineer's Review:** Engineer will promptly review the pertinent conditions, determine the necessity of Owner's obtaining additional exploration or tests with respect thereto and advise Owner in writing (with a copy to Contractor) of Engineer's findings and conclusions.

4.2.5. **Possible Contract Documents Change:** If Engineer concludes that a change in the Contract Documents is required as a result of a condition that meets one or more of the categories in paragraph 4.2.3., a Work Change Directive or a Change Order will be issued as provided in Article 10 to reflect and document the consequences of such change.

4.2.6. **Possible Price and Times Adjustments:** An equitable adjustment in the Contract Price or in the Contract Times, or both, will be allowed to the extent that the existence of such uncovered or revealed condition causes an increase or decrease in Contractor's cost of, or time required for performance of the Work; subject, however, to the following:

4.2.6.1. such condition must meet any one or more of the categories described in paragraphs 4.2.3.1 through 4.2.3.4. inclusive;

4.2.6.2. a change in the Contract Documents pursuant to paragraph 4.2.5 will not be an automatic authorization of nor a condition precedent to entitlement to any such adjustment:

4.2.6.3. 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 paragraphs 9.10 and 11.9; and

4.2.6.4. Contractor shall not be entitled to any adjustment in the Contract Price or Times if;

4.2.6.4.1. Contractor knew of the existence of such conditions at the time Contractor made a final commitment to Owner in respect of Contract Price and Contract Times by the submission of a bid or becoming bound under a contract: or

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

4.2.6.4.3. Contractor failed to give the written notice within the time and as required by paragraph 4.2.3.

If Owner and Contractor are unable to agree on entitlement to or as to the amount or length of any such equitable adjustment in the Contract Price or Contract Times, a claim may be made therefore as provided in Articles 11 and 12. However, Owner, Engineer, and Engineer's Consultants shall not 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.

4.3. Physical Conditions – Underground Facilities:

4.3.1. Shown or Indicated: The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities or by others. Unless it is otherwise expressly provided in the *Information Available to Contractors*:

4.3.1.1. Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data; and

4.3.1.2. The cost of all of the following will be included in the Contract Price and Contractor shall have full responsibility for: (i) reviewing and checking all such information and data, (ii) locating all Underground Facilities shown or indicated in the Contract Documents, (iii) coordination of the Work with the owners of such Underground Facilities during construction, and (iv) the safety and protection of all such Underground Facilities as provided in paragraph 6.20 and repairing any damage thereto resulting from the Work.

4.3.2. Not Shown or Indicated: If an Underground Facility is uncovered or revealed at or contiguous to the site which was not shown or indicated in the Contract Documents. 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 6.23), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer. Engineer will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence of the Underground Facility. If Engineer concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued as provided in Article 10 to reflect and document such consequences. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility as provided in paragraph 6.20. Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, to the extent that they are attributable to the existence of any Underground Facility that was not shown or indicated in the Contract Documents and that Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated. If Owner and Contractor are unable to agree on entitlement to or the amount or length of any such adjustment in Contract Price or Contract Times, Contractor may make a claim, therefore, as provided in Articles 11 and 12. However, Owner, Engineer, and Engineer's Consultants shall not be liable to Contractor for any claims, costs, losses or damages incurred or sustained by Contractor on or in connection with any other project or anticipated project.

Reference Points:

4.4. 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 shall make no changes or relocations without the prior written approval of Owner, Contractor shall report to Engineer whenever any reference point 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 by professionally qualified personnel.

4.5. Asbestos, PCBs, Petroleum, Hazardous Waste or Radioactive Material:

4.5.1. Owner shall be responsible for any Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material uncovered or revealed at the site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work and which may present a substantial danger to persons or property exposed thereto in connection with the Work at the site. Owner shall not be responsible for any such materials brought to the site by Contractor, Subcontractor, Suppliers, or anyone else for whom Contractor is responsible.

4.5.2. Contractor shall immediately: (i) stop all Work in connection with such hazardous condition and in any area affected thereby (except in an emergency as required by paragraph 6.23), and (ii) notify Owner and Engineer (and 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 hazardous condition to take corrective action, if any. Contractor shall not be required to resume Work in connection with such hazardous condition or in any such affected area until after Owner has obtained any required permits related thereto and delivered to Contractor special written notice: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (ii) specifying any special conditions under which such Work may be resumed safely. If Owner and Contractor cannot agree as to entitlement to or the amount or extent of an adjustment, if any, in Contract Price or Contract Times as a result of such Work stoppage or such special conditions under which Work is agreed by Contractor to be resumed, either party may make a claim therefore as provided in Articles 11 and 12.

4.5.3. If after receipt of such special 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 such portion of the Work that is in connection with such hazardous condition or in such affected area to be deleted from the Work. If Owner and Contractor cannot agree as to entitlement to or the amount or extent of an adjustment, if any, in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a claim therefore as provided in Articles 11 and 12. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 7.

4.5.4. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, Engineer, Engineer's Consultants and the officers, directors, employees, agents, other consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages arising out of or resulting from such hazardous condition, provided that: (i) any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, and (ii) nothing in this subparagraph 4.5.4. shall obligate Owner to indemnify any person or entity from and against the consequences of that person's or entity's own negligence. The foregoing notwithstanding, the owners indemnification shall be considered a waiver of the privileges, immunities and limits of liability contained in Florida Statute 768.28.

4.5.5. The provisions of paragraphs 4.2 and 4.3 are not intended to apply to Asbestos, PCBs, Petroleum, Hazardous Waste or Radioactive Material uncovered or revealed at the site.

ARTICLE 5 – BONDS AND INSURANCE

Performance, Payment, and Other Bonds:

5.1. Contractor shall furnish Performance and Payment Bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all Contractor's obligations under the Contract Documents. These Bonds shall remain in effect at least until one year after the date when final payment becomes due, 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 Supplementary Conditions. All Bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Audit Staff, Bureau of Government Financial Operations, U.S. Treasury Department. All Bonds signed by an agent must be accompanied by a certified copy of such agent's authority to act.

5.2. If the surety on any Bond furnished by Contractor is declared a bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of paragraph 5.1. Contractor shall within ten days thereafter substitute another bond and surety, both of which must be acceptable to Owner.

5.3. Licensed Sureties and Insurers; Certificates of Insurance:

5.3.1. All Bonds and insurance required by the Contract Documents to be purchased and maintained by Owner or Contractor shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue Bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

5.3.2. Contractor shall deliver to Owner, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Owner or any other additional insured) which Contractor is required to purchase and maintain in accordance with paragraph 5.4.

5.4 Contractor's Liability Insurance:

Contractor shall purchase and maintain such liability and other insurance as is appropriate for the Work being performed and furnished and as will provide protection from claims set forth below which may arise out of or result from Contractor's performance and furnishing of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed or furnished by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform or furnish any of the Work, or by anyone for whose acts any of them may be liable:

5.4.1. claims under workers' compensation, disability benefits and other similar employee benefit acts;

5.4.2. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;

5.4.3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees;

5.4.4. claims for damages insured by customary personal injury liability coverage which are sustained: (i) by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor, or by any other person for any other reason;

5.4.5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and

5.4.6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

The policies of insurance so required by this paragraph 5.4 to be purchased and maintained shall:

5.4.7. with respect to insurance required by paragraphs 5.4.3 through 5.4.6 inclusive, include as additional insureds (subject to any customary exclusion in respect of professional liability) Owner, Engineer, Engineer's Consultants and any other persons or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insureds, and include coverage for the respective officers and employees of all such additional insureds;

5.4.8. include the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;

5.4.8.1 Contractor's Liability Insurance and the Owner's Protective Liability Insurance specified above shall be provided in not less than the following amount:

a. Injury or death to more than one person or single occurrence	\$1,000,000
b. On and Off Premises Operations Liability	\$1,000,000
c. Explosion and Collapse Hazard	\$1,000,000
d. Underground Hazard	\$1,000,000
e. Completed Operations and Products Liability	\$1,000,000
f. Property damage in account of all occurrences	\$1,000,000
g. Independent Contractors Liability	\$1,000,000
h. Personal Injury Liability Insurance	\$1,000,000

Contractor's Vehicle Insurance as follows:

1. Injury or death to one person	\$1,000,000
2. Injury or death to more than one person or a single occurrence	\$1,000,000
3. Property Damage	\$1,000,000
4. Business Auto Liability, Including all owned, non owned and hired vehicles	\$1,000,000

An Umbrella Policy may be used to meet the above limits.

All policies shall be drawn to cover a period of not less than one (1) year from the date of issue.

5.4.10. include contractual liability insurance covering Contractor's indemnity obligations under paragraphs 6.12, 6.16, and 6.31 through 6.33;

5.4.11. contain a provision or endorsement that the coverage afforded will not be cancelled, materially changed or renewal refused until at least thirty days prior written notice has been given to Owner and Contractor and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Contractor pursuant to paragraph 5.3.2 will so provide);

5.4.12. remain in effect at least until final payment and at all times thereafter when Contractor may be correcting, removing or replacing **defective** Work in accordance with paragraph 13.12; and

5.4.13. with respect to completed operations insurance, and any insurance coverage written on an occurrence basis, remain in effect for at least two years after final payment (and Contractor shall furnish Owner and each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter).

5.5 Owner's Liability Insurance:

In addition to the insurance required to be provided by Contractor under paragraph 5.4, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents. Any liability insurance carried by Owner is excess and non-contributory to any and all other coverage whether collectable or not.

5.6 Property Insurance:

Contractor shall purchase and maintain property insurance upon the Work at the site in amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in these Supplementary Conditions or required by Laws and Regulations). This insurance shall:

5.6.1 include the interests of Owner, Contractor, Subcontractors, Engineer, Engineer's Consultants and any other persons or entities identified in the Supplementary Conditions each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured;

5.6.2 include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);

5.6.3 cover materials and equipment in transit for incorporation in the Work or stored at the site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer; and

5.6.4 be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with thirty days written notice to each other additional insured to whom a certificate of insurance has been issued.

5.7. NOT USED

5.8. NOT USED

5.9. Owner shall not be responsible for purchasing and maintaining any property insurance to protect the interests of Contractor, Subcontractors or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount, will be borne by Contractor, Subcontractor, or others suffering any such loss and if any of them

wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

5.10. NOT USED

5.11. NOT USED

5.12 Receipt and Application of Insurance Proceeds:

Any insureds loss under the policies of insurance required by paragraphs 5.6 and 5.7 will be adjusted with Owner and made payable to Owner as fiduciary for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause and of paragraph 5.13. Owner shall deposit in a separate account any money so received, and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof and the Work and the cost thereof covered by an appropriate Change Order or Written Amendment.

5.13. Owner as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within fifteen days after the occurrence of loss to Owner's exercise of this power. If such objection be made, Owner as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, Owner as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, Owner as fiduciary shall give bond for the proper performance of such duties.

5.14 Acceptance of Bonds and Insurance; Option to Replace:

If either party (Owner or Contractor) has any objection to the coverage afforded by or other provisions of the Bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within ten days after receipt of the certificates (or other evidence requested) required by paragraph 2.7. Owner and Contractor shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the Bonds and insurance required of such party by the Contract Documents, 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. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent Bonds or insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

5.15 Partial Utilization – Property Insurance:

If Owner finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work, such use or occupancy may be accomplished in accordance with paragraph 14.10; provided that no such use or occupancy shall commence before the insurers providing the property insurance have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be cancelled or permitted to lapse on account of any such partial use or occupancy.

ARTICLE 6 – CONTRACTOR'S RESPONSIBILITIES

6.1 Supervision and Superintendence:

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. Contractor shall be solely responsible for the means, methods, techniques, sequences and procedures of construction, but Contractor shall not be responsible for the negligence of others in the design or specification of a specific means, method, technique, sequence or procedure of construction which is shown or indicated in and expressly required by the Contract Documents. Contractor shall be responsible to see that the completed Work complies accurately with the Contract Documents.

6.2. Contractor shall keep on the Work at all times during its progress a competent resident superintendent, who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances. The superintendent will be Contractor's representative at the site and shall have authority to act on behalf of Contractor. All communications to the superintendent shall be as binding as if given to CONTRACTOR.

6.3 Labor, Materials and Equipment:

Contractor shall provide competent, suitably qualified personnel to survey, lay out and construct the Work as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the site. 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 indicated in the Contract Documents, all Work at the site shall be performed during regular working hours and Contractor will not permit overtime work or the performance of Work on Saturday, Sunday or any legal holiday without Owner's written consent given after prior written notice to Engineer.

6.4. Unless otherwise specified in the General Requirements, Contractor shall furnish and assume full responsibility for all 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 furnishing, performance, testing, start-up and completion of the Work.

6.5. All materials and equipment shall be of good quality and new, except as otherwise provided in the Contract Documents. All warranties and guarantees specifically called for by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the kind and quality of materials and equipment. All materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with instructions of the applicable Supplier, except as otherwise provided in the Contract Documents.

6.6 Progress Schedule:

Contractor shall adhere to the progress schedule established in accordance with paragraph 2.9 as it may be adjusted from time to time as provided below:

6.6.1. Contractor shall submit to Engineer for acceptance (to the extent indicated in paragraph 2.9) proposed adjustments in the progress schedule that will not change the Contract Times (or Milestones). Such adjustments will conform generally to the progress schedule then in effect and additionally will comply with any provisions of the General Requirements applicable thereto.

6.6.2. Proposed adjustments in the progress schedule that will change the Contract Times (or Milestones) shall be submitted in accordance with the requirements of paragraph 12.1. Such adjustments may only be made by a Change Order or Written Amendment in accordance with Article 12.

6.7. Substitutes and "Or-Equal" Items:

6.7.1. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be accepted by Engineer under the following circumstances:

6.7.1.1. "Or-Equal": If in Engineer's sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an "or-equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for acceptance of proposed substitute items.

6.7.1.2. Substitute Items: If in Engineer's sole discretion an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item under subparagraph 6.7.1.1, it will be considered a proposed substitute item. Contractor shall submit sufficient information as provided below to allow Engineer to determine that the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefore. The procedure for review by the Engineer will include the following as supplemented in the General Requirements and as Engineer may decide is appropriate under the circumstances. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor. If Contractor wishes to furnish or use a substitute item of material or equipment, Contractor shall first make written application to Engineer for acceptance thereof, certifying that the proposed substitute will perform adequately the functions and achieve the results called for by the general design, be similar in substance to that specified and be suited to the same use as that specified. The application will state the extent, if any, to which the evaluation and acceptance of the proposed substitute will prejudice Contractor's achievement of Substantial Completion on time, whether or not acceptance of the substitute for use 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 work on the Project) to adapt the design to the proposed substitute and whether or not incorporation or use of the substitute in connection with the Work is subject to payment of any license fee or royalty. All variations of the proposed substitute from that specified will be identified in the application and available maintenance, repair and replacement service will be indicated. The application will also contain an itemized estimate of all costs or credits that will result directly or indirectly from acceptance of such substitute, including costs of redesign and claims of other contractors affected by the resulting change, all of which will be considered by Engineer in evaluating the proposed substitute. Engineer may require Contractor to furnish additional data about the proposed substitute.

6.7.1.3. Contractor's Expense: All data to be provided by Contractor in support of any proposed "or-equal" or substitute item will be at Contractor's expense.

6.7.2. Substitute Construction Methods or Procedures: If a specific means, method, technique, sequence or procedure of construction is shown or indicated in an expressly required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence or procedure of construction acceptable to Engineer. Contractor shall submit sufficient information to allow Engineer, in Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The procedure for review by Engineer will be similar to that provided in subparagraph 6.7.1.2.

6.7.3. Engineer's Evaluation: Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to paragraphs 6.7.1.2 and 6.7.2. Engineer will be the sole judge of acceptability. No "or-equal" or substitute will be ordered, installed or utilized without Engineer's prior written acceptance which will be evidenced by either a Change Order or an approved Shop Drawing. Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any "or-equal" or substitute. Engineer will record time required by Engineer and Engineer's Consultants in evaluating substitutes proposed or submitted by Contractor pursuant to paragraphs 6.7.1.2 and 6.7.2 and in making changes in the Contract Documents (or in the provisions of any other direct contract with Owner for work on the Project) occasioned thereby. Whether or not Engineer accepts a substitute item so proposed or submitted by Contractor, Contractor shall reimburse Owner for the changes of Engineer and Engineer's Consultants for evaluating each such proposed substitute item.

6.8. Concerning Subcontractors, Suppliers and Others:

The Contractor shall submit a list of Subcontractors and major Material Suppliers for the Owner's approval within (24) hours after Bid Opening. Such list shall be accompanied by an experience statement with pertinent information as to similar projects and other evidence of qualifications from each such Subcontractor, person and organization requested by Owner. If Owner, after due investigation has reasonable objections to any proposed Subcontractor, other person or organization, the Owner may before giving the Notice of Award request the apparent successful Contractor to submit an acceptable Subcontractor without an increase in Bid Price. If the apparent successful Contractor declines to make any such substitution, the Contract shall not be awarded to such Contractor, but his declining to make any such substitution will not constitute grounds for sacrificing his Bid Security. Any Subcontractor, other person or organization so listed and to whom Owner does not make written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner.

6.8.1. Contractor shall not employ any Subcontractor, Supplier or other person or organization (including those acceptable to Owner and Engineer as indicated in paragraph 6.8.2), whether initially or as a substitute, against whom Owner or Engineer may have reasonable objection. Contractor shall not be required to employ any subcontractor, Supplier or other person or organization to furnish or perform any of the Work against whom Contractor has reasonable objection.

6.8.2. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers or other persons or organizations (including those who are to furnish the principal items of materials or equipment) to be submitted to Owner in advance of the specified date prior to the Effective Date of the Agreement for acceptance by Owner and Engineer, and if Contractor has submitted a list thereof in accordance with the Supplementary Conditions, Owner's or Engineer's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the project documents or the Contract Documents) of any such Subcontractor, Supplier or other person or organization so identified may be revoked on the basis of reasonable objection after due investigation, in which case Contractor shall submit an acceptable substitute, the Contract Price will be adjusted by the difference in the cost occasioned by such substitution and an appropriate Change Order will be issued or Written Amendment signed. No acceptance by Owner or Engineer of any such Subcontractor, Supplier or other person or organization shall constitute a waiver of any right of Owner or Engineer to reject **defective Work**.

6.9.1. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract with Contractor just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents shall create for the benefit of any such Subcontractor, Supplier, or other person or organization any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier or other person or organization, nor shall it create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier or other person or organization except as may otherwise be required by Laws and Regulations.

6.9.2. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract with Contractor. Contractor shall require all Subcontractors, Suppliers and such other persons and organizations performing or furnishing any of the Work to communicate with the Engineer through Contractor.

6.10. The divisions and sections of the Specifications and the identifications of any drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

6.11. All Work performed by Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer. Whenever any such agreement is with a Subcontractor or Supplier who is listed as an additional insured on the property insurance provided in paragraph 5.6. or 5.7. the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner, Contractor, Engineer, Engineer's Consultants and all other additional insureds for all losses and damages caused by, arising out of or resulting from any of the perils covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.

6.12 Patent Fees and Royalties:

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 a particular 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 shall be disclosed by Owner in the Contract Documents. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner, Engineer, Engineer's Consultants and the officers, directors, employees, agents and other consultants of each and any of them from and against all claims, costs, losses and damages arising out of or resulting from 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.

6.13 Permits:

Unless otherwise provided in the Supplementary Conditions, Contractor shall obtain and pay for all construction permits and licenses. 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 opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. Contractor shall pay all charges of utility owners for connections to the Work, and Owner shall pay all charges of such utility owners for capital costs related thereto such as plant investment fees.

6.14 Laws and Regulations:

6.14.1. Contractor shall give all notices and comply with all Laws and Regulations applicable to furnishing and performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.

6.14.2. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses and damages caused by, arising out of or resulting therefrom: however, it shall not be Contractor's primary responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor or Contractor's obligations under paragraph 3.3.2.

6.15 Taxes:

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.

6.16 Use of Premises:

Contractor shall confine construction equipment, the storage of materials and equipment and the operations of workers to the site and land and areas identified in and permitted by the Contract Documents, rights-of-way, permits and easements, and shall not unreasonably encumber the premises with construction equipment or other materials or equipment. Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof or of any adjacent land or areas, resulting from the performance of the Work. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law. Contractor shall, to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner, Engineer, Engineer's Consultant and anyone directly or indirectly employed by any of them from and against all claims costs, losses and damages arising out of or resulting from 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 by or based upon Contractor's performance of the Work.

6.17. During the progress of the Work, Contractor shall keep the premises free from accumulations of waste materials, rubbish and other debris resulting from the Work. At the completion of the Work Contractor shall remove all waste materials, rubbish and debris from and about the premises as well as all tools, appliances, construction equipment and machinery and surplus materials. Contractor shall leave the site clean and ready for occupancy by Owner at Substantial Completion of the Work. Contractor shall restore to original condition all property not designated for alteration by the Contract Documents.

6.18. 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 property to stresses or pressures that will endanger it.

6.19 Record Documents:

Contractor shall maintain in a safe place at the site one record copy of all Drawings, Specifications, Addenda, Written Amendments, Change Orders, Work Change Directives, Field Orders and written interpretations and clarifications (issued pursuant to paragraph 9.4) in good order and annotated to show all changes made during construction. These record documents together with all approved Samples and a counterpart of all approved Shop Drawings will be available to Engineer for reference. Upon completion of the Work, these record documents, Samples and Shop Drawings will be delivered to Engineer for Owner.

6.20 Safety and Protection:

Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

6.20.1. all persons on the Work site or who may be affected by the Work;

6.20.2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the site; and

6.20.3. other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and Underground Facilities not designated for removal, relocation or replacement in the course of construction.

Contractor shall comply with all applicable Laws and Regulations of any public body having jurisdiction for safety of persons or property or to protect them from damage, injury or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of Underground Facilities and utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation and replacement of their property. All damage, injury or loss to any property referred to in paragraph 6.20.2. or 6.20.3. caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier or any other person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, shall be remedied by Contractor (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or Engineer's Consultant 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 person or organization directly or indirectly employed by any of them). Contractor's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with paragraph 14.13. that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.21 Safety Representative:

Contractor shall designate a qualified and experienced safety representative at the site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

6.22 Hazard Communication Programs:

Contractor shall be responsible for coordinating any exchange of 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.

6.23 Emergencies:

In emergencies affecting the safety or protection of persons or the Work or property at the site or adjacent thereto, Contractor, without special instruction or authorization from Owner or Engineer, is obligated to act to prevent threatened 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 thereby. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued to document the consequences of such action.

6.24. Shop Drawings and Samples:

6.24.1. Contractor shall submit Shop Drawings to Engineer for review and approval in accordance with the accepted schedule of Shop Drawings and Sample submittals (see paragraph 2.9.). All submittals will be identified as Engineer may require and in the number of copies specified in the General Requirements. The data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials and similar data to shown Engineer the materials and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by paragraph 6.26.

6.24.2. Contractor shall also submit Samples to Engineer for review and approval in accordance with said accepted schedule of Shop Drawings and Sample submittals. Each Sample will be identified clearly as to material, Supplier, pertinent data such as catalog numbers and the use for which intended and otherwise as Engineer may require to enable Engineer to review the submittal for the limited purposes required by paragraph 6.26. The numbers of each Sample to be submitted will be as specified in the Specifications.

6.25. Submittal Procedures:

6.25.1. Before submitting each Shop Drawing or Sample, Contractor shall have determined and verified:

6.25.1.1 all field measurements, quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar information with respect thereto,

6.25.1.2. all materials with respect to intended use, fabrication, shipping, handling storage, assembly and installation pertaining to the performance of the Work, and

6.25.1.3. all information relative to Contractor's sole responsibilities in respect of means, methods, techniques, sequences and procedures of construction and safety precautions and programs incident thereto.

Contractor shall also have reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents.

6.25.2 Each submittal will bear a stamp or specific written indication that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review and approval of that submittal.

6.25.3. At the time of each submission, Contractor shall give Engineer specific written notice of such variations, if any, that the Shop Drawing or Sample submitted may have from the requirements of the Contract Documents, such notice to be in a written communication separate from the submittal; and, in

addition, shall cause a specific notation to be made on each Shop Drawing and Sample submitted to Engineer for review and approval of each such variation.

6.26. Engineer will review and approve Shop Drawings and Samples in accordance with the schedule of Shop Drawings and Sample submittals accepted by Engineer as required by paragraph 2.9. 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, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Engineer's review and approval will not extend to means, methods, techniques, sequences or procedures of construction (except where a particular means, method, technique, sequence or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions. 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.

6.27. Engineer's review and approval of Shop Drawings or Samples shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has in writing called Engineer's attention to each such variation at the time of submission as required by paragraph 6.25.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying Shop Drawing or Sample approval; nor will any approval by Engineer relieve Contractor from responsibility for complying with the requirements of paragraph 6.25.1.

6.28. Where a Shop Drawing or Sample is required by the Contract Documents or the schedule of Shop Drawings and Sample submissions accepted by Engineer as required by paragraph 2.9, 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.

Continuing the Work:

6.29. Contractor shall carry on the Work and adhere to the progress schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by paragraph 15.5 or as Owner and Contractor may otherwise agree in writing.

6.30. Contractor's General Warranty and Guarantee:

6.30.1. Contractor warrants and guarantees to Owner, Engineer and Engineer's Consultants that all Work will be in accordance with the Contract Documents and will not be defective. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

6.30.1.1. abuse, modification or improper maintenance or operation by persons other than Contractor, Subcontractors or Suppliers; or

6.30.1.2. normal wear and tear under normal usage.

6.30.2. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in

accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:

- 6.30.2.1. observations by Engineer;
- 6.30.2.2. recommendation of any progress or final payment by Engineer;
- 6.30.2.3. the issuance of a certificate of Substantial Completion or any payment by Owner to Contractor under the Contract Documents;
- 6.30.2.4. use or occupancy of the Work or any part thereof by Owner;
- 6.30.2.5. any acceptance by Owner or any failure to do so;
- 6.30.2.6. any review and approval of Shop Drawing or Sample submittal or the issuance of a notice of acceptability by Engineer pursuant to paragraph 14.13;
- 6.30.2.7. any inspection, test or approval by others; or
- 6.30.2.8. any correction of **defective** Work by Owner.

6.31 Indemnification:

To the fullest extent permitted by Laws and Regulations. Contractor shall indemnify and hold harmless Owner, Engineer, Engineer's Consultants and the officers, directors, employees, agents and other consultants 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) caused by, arising out of or resulting from the performance of the Work, provided that any such claim, cost, loss or damage: (i) is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, and (ii) is caused in whole or in part by any negligent act or omission of Contractor, any Subcontractor, any Supplier, any person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, regardless of whether or not caused in part by any negligence or omission of a person or entity indemnified hereunder or whether liability is imposed upon such indemnified party by Laws and Regulations regardless of the negligence of any such person or entity.

6.32. In any and all claims against Owner or Engineer or any of their respective consultants, agents, officers, directors or employees by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, any person or organization directly or indirectly employed by any of them to perform or furnish any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under paragraph 6.31 shall 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 person or organization under workers' compensation acts, disability benefit acts or other employee benefit acts.

6.33. The indemnification obligations of Contractor under paragraph 6.31 shall not extend to the liability of Engineer and Engineer's Consultants, officers, directors, employees or agents caused by the professional negligence, errors or omissions of any of them.

6.34 Survival of Obligations:

All representations, indemnifications, warranties and guarantees made in, required by or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion and acceptance of the Work and termination or completion of the Agreement.

ARTICLE 7 – OTHER WORK

7.1 Related Work at Site:

Owner may perform other work related to the Project at the site by Owner's own forces, or let other direct contracts therefore which shall contain General Conditions similar to these, or have other work performed by utility owners. If the fact that such other work is to be performed was not noted in the Contract Documents, then; (i) written notice thereof will be given to Contractor prior to starting any such other work, and (ii) Contractor may make a claim therefore as provided in Articles 11 and 12 if Contractor believes that such performance will involve additional expense to Contractor or requires additional time and the parties are unable to agree as to the amount or extent thereof.

7.2. Contractor shall afford each other contractor who is a party to such a direct contract and each utility owner (and Owner if Owner is performing the additional work with Owner's employees) proper and safe access to the site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work and shall properly connect and coordinate the Work with theirs. Unless otherwise provided in the Contract Documents. Contractor shall do all cutting, fitting, and patching of the Work that may be required to make its several parts come together properly and integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating or otherwise altering their work and will only cut or alter their work with the written consent of Engineer and the others whose work will be affected. The duties and responsibilities of Contractor under this paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of Contractor in said direct contracts between Owner and such utility owners and other contractors.

7.3. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 7. 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 so to report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent or non-apparent defects and deficiencies in such other work.

7.4 Coordination:

If Owner contracts with others for the performance of other work on the Project at the site, the following will be set forth in Supplementary Conditions:

7.4.1. the person, firm or corporation who will have authority and responsibility for coordination of the activities among the various prime contractors will be identified;

7.4.2. the specific matters to be covered by such authority and responsibility will be itemized; and

7.4.3. the extent of such authority and responsibilities will be provided.

Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility in respect of such coordination.

ARTICLE 8 – OWNER'S RESPONSIBILITIES

- 8.1. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.
- 8.2. In case of termination of the employment of Engineer, Owner shall appoint an engineer, whose status under the Contract Documents shall be that of the former Engineer.
- 8.3. Owner shall furnish the data required of Owner under the Contract Documents promptly and shall make payments to Contractor promptly when they are due as provided in paragraphs 14.4 and 14.13.
- 8.4. Owner's duties in respect of providing lands and easements and providing engineering surveys to establish reference points are set forth in paragraphs 4.1 and 4.4. Paragraph 4.2 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of subsurface conditions at the site and drawings of physical conditions in existing structures at or contiguous to the site that have been utilized by Engineer in preparing the Contract Documents.
- 8.5. Owner's responsibilities in respect of purchasing and maintaining liability and property insurance are set forth in paragraphs 5.5 through 5.10.
- 8.6. Owner is obligated to execute Change Orders as indicated in paragraph 10.4.
- 8.7. Owner's responsibility in respect of certain inspections, tests and approvals is set forth in paragraph 13.4.
- 8.8. In connection with Owner's right to stop Work or suspend Work, see paragraphs 13.10 and 15.1. Paragraph 15.2 deals with Owner's right to terminate services of Contractor under certain circumstances.
- 8.9. 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 furnishing or performance of the Work. Owner will not be responsible for Contractor's failure to perform or furnish the Work in accordance with the Contract Documents.
- 8.10. Owner's responsibility in respect of undisclosed Asbestos, PCBs, Petroleum, Hazardous Waste or Radioactive Materials uncovered or revealed at the site is set forth in paragraph 4.5.
- 8.11. If and to the extent Owner has agreed to furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents, Owner's responsibility in respect thereof will be as set forth in the Supplementary Conditions.

ARTICLE 9 – ENGINEER'S STATUS DURING CONSTRUCTION

9.1 Owner's Representative:

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 Documents and shall not be extended without written consent of Owner and Engineer.

9.2 Visits to Site:

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 will endeavor for the benefit of Owner to determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous on-site inspections 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 on-site observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work. Engineer's visits and on-site observations are subject to all the limitations on Engineer's authority and responsibility set forth in paragraph 9.13, and particularly, but without limitation, during or as a result of Engineer's on-site 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 furnishing or performance of the Work.

9.3 Project Representative:

If Owner and Engineer agree, Engineer will furnish a Resident Project Representative to assist Engineer in providing more continuous observation of the Work. The responsibilities and authority and limitations thereon of any such Resident Project Representative and assistants will be as provided in paragraph 9.13 and in the Supplementary Conditions. If Owner designates another representative or agent to represent Owner at the site who is not Engineer's Consultant, agent or employee, the responsibilities and authority and limitations thereon of such other person will be as provided in the Supplementary Conditions.

9.3.1 Engineer may furnish a Resident Project Representative, assistants and other field staff as needed, to assist Owner in observing performance of the Work. The Resident Project Representative is to observe and inspect, in the Owner's interest, the materials furnished and the work done as the work progresses in order to insure full and complete compliance with the contract and to verify quantities of work completed.

9.3.2 Owner may also designate one of its employees to represent Owner for these purposes.

9.3.3 Engineer, Resident Project Representative, Owner and all such other persons referred to shall have unrestricted access to all parts of the Work. Contractor shall cooperate by supplying necessary facilities and assistance required by above persons to carry out their work of observation and inspection.

9.3.4 It is not the function of the Engineer, Resident Project Representative or Owner to supervise or direct the manner in which the work to be done under this Contract is carried on or conducted. The Engineer, Resident Project Representative or Owner is not responsible for construction means, methods, techniques, sequences or procedures, or for safety precautions and programs in connection with the work, and they will not be responsible for the Contractor's failure to carry out the work in accordance with the Contract Documents. Nevertheless, Contractor agrees that any method or procedure, which in the opinion of the Engineer or Owner does not achieve the required results or quality of the work specified, shall be discontinued immediately upon the order of the Engineer.

9.3.5 *All communications between Contractor and Engineer or Contractor and Owner are to be through the Resident Project Representative.*

9.3.6 *Duties and Responsibilities of Resident Project Representative (RPR):*

- 1) *RPR will act as directed by and under the supervision of Engineer and/or Owner, and will confer with Engineer and Owner regarding RPR's actions. RPR's dealings in matters pertaining to the on-site work shall in general be with Engineer and Contractor keeping Owner advised as necessary. RPR's dealings with subcontractors shall only be through or with the full knowledge and approval of Contractor.*
- 2) *Review progress schedule, schedule of Shop Drawing submittals and schedule of values prepared by Contractor and consult with Engineer and Owner concerning acceptability.*
- 3) *Attend meetings with Contractor, such as pre-construction conferences, progress meetings, job conferences and other project-related meetings, and prepare and circulate copies of minutes thereof.*
- 4) *Serve as Engineer's and Owner's liaison with Contractor, working principally through Contractor's superintendent and assist in understanding the intent of the Contract Documents.*
- 5) *Advise Engineer, Owner and Contractor of the commencement of any Work requiring a Shop Drawing or sample if the submittal has not been approved by Engineer.*
- 6) *Conduct on-site observations of the Work in progress to assist Engineer and Owner in determining if the Work is in general proceeding in accordance with the Contract Documents. Report to Engineer and Owner whenever RPR believes that any Work is unsatisfactory, faulty or defective or does not conform to the Contract Documents, or has been damaged, or does not meet the requirements of any inspection, test or approval required to be made; and advise Engineer and Owner of Work that RPR believes should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.*
- 7) *Report to Engineer and Owner when clarifications and interpretations of the Contract Documents are needed and transmit to Contractor clarifications and interpretations as issued by Engineer.*
- 8) *Consider and evaluate Contractor's suggestions for modifications in Drawings or Specifications and report with RPR's recommendations to Engineer and Owner. Transmit to Contractor decisions as issued by Engineer and/or Owner.*
- 9) *Maintain orderly files for correspondence, reports of job conferences, Shop Drawings and samples, reproductions of original Contract Documents including all Work Directive Changes, Addenda, Change Orders, Field Orders, additional Drawings issued subsequent to the execution of the Contract, Engineer's clarifications and interpretations of the Contract Documents, progress reports, and other Project related documents.*
- 10) *Keep a diary or log book, recording Contractor hours on the job site, weather conditions, data relative to questions of Work Directive Changes, Change Orders or Changed conditions, list of job site visitors, daily activities, decisions, observations in general, and specific observations in more detail as in the case of observing test procedures; and send copies to Engineer and Owner.*

- 11) *Record names, addresses and telephone numbers of all Contractors, subcontractors and major suppliers of materials and equipment.*
- 12) *Furnish Engineer and Owner periodic reports as required of progress of the Work and of Contractor's compliance with the progress schedule and schedule of Shop Drawing and sample submittals.*
- 13) *Draft proposed Change Orders and Work Directive Changes, obtaining backup material from Contractor and recommend to Engineer and Owner Change Orders, Work Directive Changes, and Field Orders.*
- 14) *Report immediately to Engineer and Owner upon the occurrence of any accident.*
- 15) *Review applications for payment with Contractor for compliance with the established procedure for their submission and forward with recommendations to Engineer, noting particularly the relationship of the payment requested to the schedule of values, Work completed and materials and equipment delivered at the site but not incorporated in the Work.*
- 16) *During the course of the Work, verify that certificates, maintenance and operation manuals and other data required to be assembled and furnished by Contractor are applicable to the items actually installed and in accordance with the Contract Documents, and have this material delivered to Engineer for review and forwarding to Owner prior to final payment for the work.*
- 17) *Before Engineer issues a Certificate of Substantial Completion, submit to Contractor a list of observed items requiring completion or correction.*
- 18) *Conduct final inspection in the company of Engineer, Owner and Contractor and prepare a final list of items to be completed or corrected.*
- 19) *Observe that all items on final list have been completed or corrected and make recommendations to Engineer and Owner concerning acceptance.*

9.3.7 *Limitations of Authority of Resident Project Representative (RPR):*

- 1) *Shall not authorize any deviation from the Contract Documents or substitution of materials or equipment, unless authorized by Engineer or Owner.*
- 2) *Shall not exceed limitations of Engineer's authority as set forth in the Contract Documents.*
- 3) *Shall not undertake any of the responsibilities of Contractor, subcontractors or Contractor's superintendent.*
- 4) *Shall not advise on, issue directions relative to or assume control over any aspect of the means, methods, techniques, sequences or procedures of construction unless such advice or directions are specifically required by the Contract Documents.*
- 5) *Shall not advise on, issue directions regarding or assume control over safety precautions and programs in connection with the Work.*
- 6) *Shall not accept Shop Drawing or sample submittals from anyone other than Contractor.*

9.3.8 *The Engineer and or Owner shall have the authority to reject any work, or materials, or any part thereof, which does not in his opinion conform to the plans, drawings, specifications and contract, and it shall be permissible for him to do so at any time during the progress of the work and until its acceptance.*

No material of any kind shall be used upon the work until it has been inspected and accepted by the Engineer. All materials rejected shall be removed immediately from the work and not again offered for inspection. Any materials or workmanship found at any time to be defective or not of the quality or character required by the plans and specifications shall be remedied at once regardless of previous inspection.

Such inspection shall not relieve the Contractor from any obligation to perform said work strictly in accordance with the plans and specifications and work not so constructed shall be removed and made good by the Contractor at his own expense, and free from all expense to the Owner whenever so ordered by the Owner without reference to any previous oversight or error in inspection.

9.4 Clarifications and Interpretations:

Engineer will issue with reasonable promptness such written clarifications or interpretations of the requirements of the Contract Documents (in the form of Drawings or otherwise) as Engineer may determine necessary, which shall be consistent with the intent of and reasonably inferable from Contract Documents. Such written clarifications and interpretations will be binding on Owner and Contractor. If Owner or Contractor believes that a written clarification or interpretation justifies an adjustment in the Contract Price or the Contract Times and the parties are unable to agree to the amount or extent thereof, if any, Owner or Contractor may make a written claim therefore as provided in Article 11 or Article 12.

9.5 Authorized Variations in Work:

Engineer may authorize minor variations in the Work from the requirements of the Contract Documents which 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. These may be accomplished by a Field Order and will be binding on Owner and also on Contractor who shall perform the Work involved promptly. If Owner or Contractor believes that a Field Order justifies an adjustment in the Contract Price or the Contract Times and the parties are unable to agree as to the amount or extent thereof, Owner or Contractor may make a written claim therefore as provided in Article 11 or 12.

9.6 Rejecting Defective Work:

Engineer will have authority to disapprove or reject Work which Engineer believes to be defective, or that Engineer believes will not produce a complete Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Engineer will also have authority to require special inspection or testing of the Work as provided in paragraph 13.9, whether or not the Work is fabricated, installed or completed.

9.7 Shop Drawings, Change Orders and Payments:

In connection with Engineer's authority as to Shop Drawings and Samples, see paragraphs 6.24 through 6.28 inclusive.

9.8. In connection with Engineer's authority as to Change Orders, see Articles 10,11, and 12.

9.9. In connection with Engineer's authority as to Applications for Payment, see Article 14.

9.10 Determinations for Unit Prices:

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 upon Owner and Contractor, unless, within ten days after the date of any such decision, either Owner or Contractor delivers to the other and to Engineer written notice of intention to appeal from Engineer's decision and, a formal proceeding is instituted by the appealing party in a forum of competent jurisdiction to exercise such rights or remedies as the appealing party may have with respect to Engineer's decision, unless otherwise agreed in writing by Owner and Contractor. Such appeal will not be subject to procedures of paragraph 9.11.

9.11 Decisions on Disputes:

Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work there under. Claims, disputes and other matters relating to the acceptability of the Work or the interpretation of the requirements of the Contract Documents pertaining to the performance and furnishing of the Work and Claims under Articles 11 and 12 in respect of changes in the Contract Price or Contract Times will be referred initially to Engineer in writing with a request for a formal decision in accordance with this paragraph. Written notice of each such claim, dispute or other matter will be delivered by the claimant to Engineer and the other party to the Agreement promptly (but in no event later than thirty days) after the start of the occurrence or event giving rise thereto, and written supporting data will be submitted to Engineer and the other party within sixty days after the start of such occurrence or event unless Engineer allows an additional period of time for the submission of additional or more accurate data in support of such claim, dispute or other matter. The opposing party shall submit any response to Engineer and the claimant within thirty days after receipt of the claimant's last submittal (unless Engineer allows additional time). Engineer will render a formal decision in writing within thirty days after receipt of the opposing party's submittal, if any, in accordance with this paragraph. Engineer's written decision on such claim, dispute or other matter will be final and binding upon Owner and Contractor unless: a written notice of intention to appeal from Engineer's written decision is delivered by Owner or Contractor to the other and to Engineer within thirty days after the date of such decision and a formal proceeding is instituted by the appealing party in a forum of competent jurisdiction to exercise such rights or remedies as the appealing party may have with respect to such claim, dispute or other matter in accordance with applicable Laws and Regulations within sixty days of the date of such decision, unless otherwise agreed in writing by Owner and Contractor.

9.12. When functioning as interpreter and judge under paragraphs 9.10 and 9.11, Engineer will not show partiality to Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity. The rendering of a decision by Engineer pursuant to paragraphs 9.10 or 9.11 with respect to any such claim, dispute or other matter (except any which have been waived by the making or acceptance of final payment as provided in paragraph 14.15) will be a condition precedent to any exercise by Owner or Contractor of such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any such claim, dispute or other matter.

9.13. Limitations on Engineer's Authority and Responsibilities:

9.13.1. Neither Engineer's authority or responsibility under this Article 9 or under any other provision of the Contract Documents 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 shall create, impose or give rise to any duty owed by Engineer to Contractor, any Subcontractor, and Supplier, any other person or organization, or to any surety for employee or agent of any of them.

9.13.2. 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 furnishing or performance of the Work. Engineer will not be responsible for Contractor's failure to perform or furnish the Work in accordance with the Contract Documents.

9.13.3. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other person or organization performing or furnishing any of the Work.

9.13.4. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds and certificates of inspection, tests, and approvals and Other documentation required to be delivered by paragraph 4.12 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.

9.13.5. the limitations upon authority and responsibility set forth in this paragraph 9.13 shall also apply to Engineer's Consultants, Resident Project Representative and assistants.

ARTICLE 10 – CHANGES IN THE WORK

10.1. Without invalidating the Agreement and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions or revisions in the Work. Such additions, deletions or revisions will be authorized by a Written Amendment, a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

10.2. If Owner and Contractor are unable to agree as to the extent, if any, of an adjustment in the Contract Price or an adjustment of the Contract Times that should be allowed as a result of a Work Change Directive, a claim may be made therefore as provided in Article 11 or Article 12.

10.3. 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 and supplemented as provided in paragraphs 3.5 and 3.6 except in the case of an emergency as provided in paragraph 6.23 or in the case of uncovering Work as provided in paragraph 13.9.

10.4. Owner and Contractor shall execute appropriate Change Orders recommended by Engineer covering:

10.4.1. changes in the Work which are (i) ordered by Owner pursuant to paragraph 10.1, (ii) required because of acceptance of defective Work under paragraph 13.13 or correcting defective Work under paragraph 13.14, or (iii) agreed to by the parties;

10.4.2. changes in the Contract Price or Contract Times which are agreed to by the parties; and

10.4.3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by Engineer pursuant to paragraph 9.11;

Provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the progress schedule as provided in paragraph 6.29.

10.5. If notice 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) is required by the provisions of any Bond to be given to a surety, the giving of any such notice will be Contractor's responsibility, and the amount of each applicable Bond will be adjusted accordingly.

ARTICLE 11 – CHANGE OF CONTRACT PRICE

11.1. The Contract Price constitutes the total compensation (subject to authorized adjustments) payable to Contractor for performing the Work. All duties, responsibilities and obligations assigned to or undertaken by Contractor shall be at Contractor's expense without change in the Contract Price.

11.2. The Contract Price may only be changed by a Change Order. Any claim for an adjustment in the Contract Price shall be based on written notice delivered by the party making the claim to the other party and to Engineer promptly (but in no event later than ten days) after the start of the occurrence or event giving rise to the claim and stating the general nature of the claim. Notice of the amount of the claim with supporting data shall be delivered within thirty days after the start of such occurrence or event (unless Engineer allows additional time for claimant to submit additional or more accurate data in support of the claim) and shall be accompanied by claimant's written statement that the adjustment claimed covers all known amounts to which the claimant is entitled as a result of said occurrence or event. All claims for adjustment in the Contract Price shall be determined by Engineer in accordance with paragraph 9.11 if Owner and Contractor cannot otherwise agree on the amount involved. No claim for an adjustment in the Contract Price will be valid if not submitted in accordance with this paragraph 11.2.

11.3 The value of any Work covered by a Change Order or of any claim for an adjustment in the Contract Price will be determined as follows:

11.3.1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of paragraphs 11.9.1. through 11.9.3. inclusive);

11.3.2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with paragraph 11.6.2):

11.3.3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under paragraph 11.3.2, on the basis of the Cost of the Work (determined as provided in paragraphs 11.4 and 11.5) plus a Contractor's fee for overhead and profit (determined as provided in paragraph 11.6).

11.4 Cost of the Work Covered by a Change Order:

The term Cost of the Work means the sum of all costs necessarily incurred and paid by Contractor in the proper performance of the Work. Except as otherwise may be agreed to in writing by Owner, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall include only the following items and shall not include any of the costs itemized in paragraph 11.5.

11.4.1. 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. Such employees shall include without limitation superintendents, foremen and other personnel employed full-time at the site. Payroll costs for employees not employed full-time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits which shall include social security contributions, unemployment, excise and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work after regular working hours, on Saturday, Sunday or legal holidays, shall be included in the above to the extent authorized by Owner.

11.4.2. 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 shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.

11.4.3. Payments made by Contractor to the Subcontractors for Work performed or furnished 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 who will then determine, with the advice of Engineer, which bids, if any, will be accepted. 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 shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in paragraphs 11.4, 11.5, 11.6 and 11.7. All subcontracts shall be subject to the other provisions of the Contract Documents insofar as applicable.

11.4.4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys and accountants) employed for services specifically related to the Work.

11.4.5. Supplemental costs including the following:

11.4.5.1. The proportion of necessary transportation, travel and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.

11.4.5.2. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office and temporary facilities at the site and hand tools not owned by the workers, 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.

11.4.5.3. Rentals of all construction equipment and machinery and the parts thereof whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, installation, dismantling and removal thereof – all in accordance with the terms of said rental agreements. The rental of any such equipment, machinery or parts shall cease when the use thereof is no longer necessary for the Work.

11.4.5.4. Sales, consumer, use or similar taxes related to the work, and for which Contractor is liable, imposed by Laws and Regulations.

11.4.5.5. 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.

11.4.5.6. 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 and furnishing of the Work (except losses and damages within the deductible amounts of property insurance established by Owner in accordance with paragraph 5.9), provided they 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 shall include settlements made with the written consent and approval of Owner. No such losses, damages and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee. If, however, any such loss or damage requires reconstruction and Contractor is placed in charge thereof, Contractor is placed in charge thereof, Contractor shall be paid for services a fee proportionate to that stated in paragraph 11.6.2.

11.4.5.7. The cost of utilities, fuel and sanitary facilities at the site.

11.4.5.8. Minor expenses such as telegrams, long distance telephone calls, telephone service at the site, expressage and similar petty cash items in connection with the Work.

11.4.5.9. Cost of premiums for additional Bonds and insurance required because of changes in the Work.

11.5. The term Cost of the Work Covered by a Change Order shall not include any of the following:

11.5.1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnership and sole proprietorships), general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks and other personnel employed by Contractor whether at the site or in Contractor's principal or a branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in paragraph 11.4.1 or specifically covered by paragraph 11.4.4 – all of which are to be considered administrative costs covered by the Contractor's fee.

11.5.2. Expenses of Contractor's principal and branch offices other than Contractor's office at the site.

11.5.3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

11.5.4. Cost of premiums for all Bonds and for all insurance whether or not Contractor is required by the Contract Documents to purchase and maintain the same (except for the cost of premiums covered by subparagraph 11.4.5.9 above).

11.5.5. 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.

Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in paragraph 11.4.

11.6. The Contractor's fee allowed to Contractor for overhead and profit shall be determined as follows:

11.6.1. a mutually acceptable fixed fee; or

11.6.2. 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:

11.6.2.1. for costs incurred under paragraphs 11.4.1 and 11.4.2, the Contractor's fee shall be ten percent;

11.6.2.2. for costs incurred under paragraph 11.4.3, the Contractor's fee shall be five percent.

11.6.2.3. 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 11.4.1, 11.4.2, 11.4.3 and 11.6.2 is that the Subcontractor who actually performs or furnishes the Work, at whatever tier, will be paid a fee of ten percent of the costs incurred by such Subcontractor under paragraphs 11.4.1 and 11.4.2 and that any higher tier Subcontractor and Contractor will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor:

11.6.2.4. no fee shall be payable on the basis of costs itemized under paragraphs 11.4.4, 11.4.5 and 11.5;

11.6.2.5. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and

11.6.2.6. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with paragraphs 11.6.2.1 through 11.6.2.5, inclusive.

11.7. Whenever the cost of any work is to be determined pursuant to paragraphs 11.4 and 11.5, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in form acceptable to Engineer an itemized cost breakdown together with supporting data.

Cash Allowances:

11.8. NOT USED

11.9. Unit Price Work:

11.9.1. 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 established unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement. 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. Determinations of the actual quantities and classifications of Unit Price Work performed by Contractor will be made by Engineer in accordance with paragraph 9.10.

11.9.2. 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.

11.9.3. Owner or Contractor may make a claim for an adjustment in the Contract Price in accordance with Article 11 if:

11.9.3.1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and

11.9.3.2. there is no corresponding adjustment with respect to any other item of Work; and

11.9.3.3. if Contractor believes that Contractor is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 12 – CHANGE OF CONTRACT TIMES

12.1. The Contract Times (or Milestones) may only be changed by a Change Order or a Written Amendment. Any claim for an adjustment of the Contract Times (or Milestones) shall be based on written notice delivered by the party making the claim to the other party and to Engineer promptly (but in no event later than thirty days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the extent of the claim with supporting data shall be delivered within sixty days after such occurrence (unless Engineer allows an additional period of time to ascertain more accurate data in support of the claim) and shall be accompanied by the claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant has reason to believe it is entitled as a result of the occurrence of said event. All claims for adjustment in the Contract Times (or Milestones) shall be determined by Engineer in accordance with paragraph 9.11 if Owner and Contractor cannot otherwise agree. No claim for an adjustment in the Contract Times (or Milestones) will be valid if not submitted in accordance with the requirements of this paragraph 12.1.

12.2. All time limits stated in the Contract Documents are of the essence of the Agreement.

12.3. Where Contractor is prevented from completing any part of the Work within the Contract Times (or Milestones) due to delay beyond the control of Contractor, the Contract Times (or Milestones) will be extended in an amount equal to the time lost due to such delay if a claim is made therefore as provided in paragraph 12.1. Delays beyond the control of Contractor shall include, but not be limited to, acts or neglect by Owner, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions or acts of God. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

12.4. Where Contractor is prevented from completing any part of the Work within the Contract Times (or Milestones) due to delay beyond the control of both Owner and Contractor, an extension of the Contract Times (or Milestones) in an amount equal to the time lost due to such delay shall be Contractor's sole and exclusive remedy for such delay. In no event shall Owner be liable to Contractor, any Subcontractor, any Supplier, any other person or organization, or to any surety for or employee or agent of any of them, for damages arising out of or resulting from (i) delays caused by or within the control of Contractor, or (ii) delays beyond the control of both parties including but not limited to fires, floods, epidemics, abnormal weather conditions, acts of God or acts or neglect by utility owners or other contractors performing other work as contemplated by Article 7.

ARTICLE 13 – TESTS AND INSPECTION: CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

13.1. Notice of Defects: Prompt notice of all defective Work of which Owner or Engineer have actual knowledge will be given to Contractor. All defective Work may be rejected, corrected or accepted as provided in this Article 13.

13.2 Access to Work:

Owner, Engineer, Engineer's Consultants, other representatives and personnel of Owner, independent testing laboratories and governmental agencies with jurisdictional interests will have access to the Work at reasonable times for their observation, inspecting and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's site safety procedures and programs so that they may comply therewith as applicable.

13.3 Tests and Inspections:

Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests or approvals, and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

13.4. Contractor shall employ and pay for services of an independent testing laboratory to perform all Quality Control inspections, test or approvals required by the contract documents. Contractor shall allow the Engineer access to all work done in the project for Acceptance Testing by the owner. This testing will be in addition to Quality Control Testing required by the Contractor. Owner shall arrange and pay all costs associated with Acceptance Testing done by an independent testing laboratory of the Owners choosing except:

13.4.1. for inspections, tests or approvals covered by paragraph 13.5 below.

13.4.2. that costs incurred in connection with tests or inspections conducted pursuant to paragraph 13.9 below shall be paid as provided in said paragraph 13.9; and

13.4.3. as otherwise specifically provided in the Contract Documents.

13.4.4. Owner shall perform the following test as part of quality assurance / acceptance testing:

All material testing included in the Bidding Documents.

All other required testing is to be completed by the contractor as part of the contractor's quality control procedures and submittals. This section shall take precedence over all other sections that describe testing requirements.

13.5. 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. Contractor shall also be responsible for arranging and obtaining and shall pay all costs in

connection with any inspections, tests or approvals required for Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work, or of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Quality Control Testing of materials and equipment shall be the responsibility of the Contractor who shall pay all costs associated with the required testing. Contractor shall provide the Engineer adequate advance notice of intended tests to allow the Engineer to be present during the Testing.

13.6. 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, it must, if requested by Engineer, be uncovered for observation.

13.7. Uncovering Work as provided in paragraph 13.6 shall be at Contractor's expense unless Contractor has given Engineer timely notice of Contractor's intention to cover the same and Engineer has not acted with reasonable promptness in response to such notice.

13.8 Uncovering Work:

If any Work is covered contrary to the written request of Engineer, it must, if requested by Engineer, be uncovered for Engineer's observation and replaced at Contractor's expense.

13.9. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, 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, furnishing all necessary labor, material and equipment. If it is found that such Work is defective, Contractor shall pay all claims, costs, losses and damages caused by, arising out of or resulting from 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 Owner shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, may make a claim therefore as provided in Article 11. If, however, such Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times (or Milestones), or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement and reconstruction; and, if the parties are unable to agree as to the amount or extent therefore, Contractor may make a claim therefore as provided in Articles 11 and 12.

13.10 Owner May Stop the Work:

If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to furnish or perform the Work in such a way that the completed Work will conform to the Contract Documents, 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 shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor or any surety or other party.

13.11 Correction or Removal of Defective Work:

If required by Engineer, Contractor shall promptly, as directed, either correct all defective Work, whether or not fabricated, installed or completed, or, if the Work has been rejected by Engineer, remove it from the site and replace it with Work that is not defective. Contractor shall pay all claims, costs, losses and damages caused by or resulting from such correction or removal (including but not limited to all costs of repair or replacement of work of others).

13.12. Correction Period:

13.12.1. If within one year after the date of Substantial Completion or such longer period of time as may be prescribed by Laws or Regulations or by the terms of any applicable special guarantee required by the Contract Documents or by any specific provision of the Contract Documents, any Work is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instruction: (i) correct such defective Work, or, if it has been rejected by Owner, remove it from the site and replace it with Work that is not defective, and (ii) satisfactorily correct or remove and replace any damage to other Work or the work of others resulting there from. If Contractor does not promptly comply with the terms of such instructions, or in any emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or the rejected Work removed and replaced, and all claims, costs, losses and damages caused by or resulting from such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by Contractor.

13.12.2. 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 or by Written Amendment.

13.12.3. Where defective Work (and damage to other Work resulting there from) has been corrected, removed or replaced under this paragraph 13.12, 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.

13.13 Acceptance of Defective Work:

If, instead of requiring correction or removal and replacement of defective Work, Owner (and, prior to Engineer's recommendation of final payment, also Engineer) prefers to accept it, Owner may do so. 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). If any such acceptance occurs prior to Engineer's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, Owner may make a claim therefore as provided in Article 11. If the acceptance occurs after such recommendation, an appropriate amount will be paid by Contractor to Owner.

13.14 Owner May Correct Defective Work:

If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work or to remove and replace rejected Work as required by Engineer in accordance with paragraph 13.11, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, Owner may, after seven days' written notice to Contractor, correct and remedy any such deficiency. In exercising the rights and remedies under this paragraph Owner shall proceed expeditiously. In connection with such corrective and 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, take possession of Contractor's tools, appliances, construction equipment and machinery at the site 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 representative, 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. All claims, costs, losses and damages incurred or sustained by Owner in exercising such rights and remedies will be charged against Contractor and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, Owner may make a

claim therefore as provided in Article 11. 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. Contractor shall not be allowed an extension of the Contract Times (or Milestones) because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies hereunder.

ARTICLE 14 – PAYMENTS TO CONTRACTOR AND COMPLETION

14.1 Schedule of Values:

The schedule of values established as provided in paragraph 2.9 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed.

14.2 Application for Progress Payment:

At least ten days before the date established 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. 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 shall also be accompanied by a bill of sale, invoice or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance and other arrangements to protect Owner's interest therein, all of which will be satisfactory to Owner. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

14.3 Contractor's Warranty of Title:

Contractor warrants and guarantees that title to all Work, materials and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to Owner no later than the time of payment free and clear of all Liens.

14.4 Review of Applications for Progress Payment:

Engineer will, within ~~ten~~ *fifteen (15)* days after receipt of each Application for Payment, 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. ~~Ten~~ *Thirty (30)* days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended will (subject to the provisions of the last sentence of paragraph 14.7) become due and when due will be paid by Owner to Contractor.

14.5. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's on-site 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:

14.5.1. the Work has progressed to the point indicated.

14.5.2. 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, to the results of any subsequent tests called for in the Contract Documents, to a final determination of quantities and

classifications for Unit Price Work under paragraph 9.10, and to any other qualifications stated in the recommendation), and

14.5.3. 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.

However, by recommending any such payment Engineer will not thereby be deemed to have represented that: (i) exhaustive or continuous on-site inspections have been made to check the quality or the quantity of the Work beyond the responsibilities specifically assigned to Engineer in the Contract Documents or (ii) that 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.

14.6. Engineer's recommendation of any payment, including final payment, shall not mean that Engineer is 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 furnishing or performance of Work, or for any failure of Contractor to perform or furnish Work in accordance with the Contract Documents.

14.7. 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 referred to in paragraph 14.5. Engineer may also refuse to recommend any such payment, or, because of subsequently discovered evidence or the results of subsequent inspections or tests, nullify any such payment previously recommended, to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:

14.7.1. the Work is defective, or completed Work has been damaged requiring correction or replacement.

14.7.2. the Contract Price has been reduced by Written Amendment or Change Order.

14.7.3. Owner has been required to correct defective Work or complete Work in accordance with paragraph 13.14. or

14.7.4. Engineer has actual knowledge of the occurrence of any of the events enumerated in paragraphs 15.2.1 through 15.2.4 inclusive.

Owner may refuse to make payment of the full amount recommended by Engineer because:

14.7.5. claims have been made against Owner on account of Contractor's performance or furnishing of the Work.

14.7.6. 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,

14.7.7. there are other items entitling Owner to a set-off against the amount recommended, or

14.7.8. Owner has actual knowledge of the occurrence of any of the events enumerated in paragraphs 14.7.1 through 14.7.3 or paragraphs 15.2.1 through 15.2.4 inclusive;

but Owner must give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, when Contractor corrects to Owner's satisfaction the reasons for such action.

14.8 Substantial Completion:

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 (except for items specifically listed by Contractor as incomplete) and request that Engineer issue a certificate of Substantial Completion. Within a reasonable time thereafter, 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 therefore. If Engineer considers the Work substantially complete, Engineer will prepare and deliver to Owner a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the tentative certificate during which to make written objection to Engineer as to any provisions of the certificate or attached list. If, after considering such objections, Engineer concludes that the Work is not substantially complete, Engineer will within fourteen days after submission of the tentative certificate to Owner notify Contractor in writing, stating the reasons therefore. If, after consideration of Owner's objections, Engineer considers the Work substantially complete, Engineer will within said fourteen days execute and deliver to Owner and Contractor a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as Engineer believes justified after consideration of any objections from Owner. At the time of delivery of the tentative certificate of Substantial Completion Engineer will deliver to Owner and Contractor a written recommendation as to division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, maintenance, heat, utilities, insurance and warranties and guarantees. Unless Owner and Contractor agree otherwise in writing and so inform Engineer in writing prior to Engineer's issuing the definitive certificate of Substantial Completion, Engineer's aforesaid recommendation will be binding on Owner and Contractor until final payment.

14.9. Owner shall have the right to exclude Contractor from the Work after the date of Substantial Completion, but Owner shall allow Contractor reasonable access to complete or correct items on the tentative list.

14.10 Partial Utilization:

Use by Owner at Owner's option of any substantially completed part of the Work which: (i) has specifically been identified in the Contract Documents, or (ii) 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, may be accomplished prior to Substantial Completion of all the Work subject to the following:

14.10.1. Owner at any time may request Contractor in writing to permit Owner to use any such part of the Work which Owner believes to be ready for its intended use and substantially complete. If Contractor agrees that such part of the Work is substantially complete, Contractor will certify to Owner and Engineer that such part of the Work is substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work. Contractor at any time may notify Owner and Engineer in writing that Contractor considers any such part of the Work ready for its intended use and substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work. 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 therefore. If Engineer considers that part of the Work to be substantially complete, the provisions of paragraphs 14.8 and 14.9 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.

14.10.2. No occupancy or separate operation of part of the Work will be accomplished prior to compliance with the requirements of paragraph 5.15 in respect of property insurance.

Owner may at any time request Contractor in writing to permit Owner to take over operation of any such part of the work although it is not substantially complete. A copy of such request will be sent to Engineer and within a reasonable time thereafter Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion and will prepare a list of the items remaining to be completed or corrected thereon before final payment. If Contractor does not object in writing to Owner and Engineer that such part of the Work is not ready for separate operation by Owner, Engineer will finalize the list if items to be completed or corrected and will deliver such lists to Owner and Contractor together with a written recommendation as to the division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, maintenance, utilities, insurance, warranties and guarantees for that part of the Work which will become binding upon Owner and Contractor at the time when Owner takes over such operation (unless they shall have otherwise agreed in writing and so informed Engineer). During such operation and prior to Substantial Completion of such part of the Work, Owner shall allow Contractor reasonable access to complete or correct items on said list and to complete other related Work.

14.11 Final Inspection:

Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will 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 is incomplete or **defective**. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

14.12 Final Application for Payment:

After Contractor has completed all such corrections to the satisfaction of Engineer and delivered in accordance with the Contract Documents all maintenance and operating instructions, schedules, guarantees, Bonds, certificates or other evidence of insurance required by paragraph 5.4, certificates of inspection, marked-up record documents (as provided in paragraph 6.19) and other documents, Contractor may make application for final payment following the procedure for progress payments. The final Application for Payment shall be accompanied (except as previously delivered) by:

(i) consent of the surety, if any, to final payment.

(ii) complete and legally effective releases or waivers (satisfactory to Owner) of all Liens arising out of or filed in connection with the Work. In lieu of such releases or waivers of Liens and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (i) the releases and receipts include all labor, services, material and equipment for which a Lien could be filed, and (ii) all payrolls, material and equipment bills and other indebtedness connected with the Work for which Owner or Owner's property might in any way be responsible 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.

(iii) certification from surety that payment and performance bond shall remain in effect one (1) year following final payment.

(iv) contractor's advertisement of completion – advertisement for a period of four (4) successive weeks in the newspaper or largest circulation published within the county where the work is performed.

(v) certification from insurance company that any insurance coverage written on a claims-made basis, remain in effect for at least two (2) years following final payment.

14.13 Final Payment and Acceptance:

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 Documents have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of payment and present the Application to Owner for payment. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of paragraph 14.15. Otherwise, Engineer will return the Application 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. Thirty days after the presentation to Owner of the Application and accompanying documentation, in appropriate form and substance and with Engineer's recommendation and notice of acceptability, the amount recommended by Engineer will become due and will be paid by Owner to Contractor.

14.14. If, through no fault of Contractor, final completion of the Work is significantly delayed and if Engineer so confirms, Owner shall, upon receipt of Contractor's final Application for Payment and recommendation of Engineer, and without terminating the Agreement, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by Owner for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if Bonds have been furnished as required in paragraph 5.1, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by Contractor to Engineer with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

14.15 Waiver of Claims:

The making and acceptance of final payment will constitute:

14.15.1. a waiver of all claims by Owner against Contractor, except claims arising from unsettled Liens, from **defective** Work appearing after final inspection pursuant to paragraph 14.11, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and

14.15.12. a waiver of all claims by Contractor against Owner other than those previously made in writing and still unsettled.

ARTICLE 15 – SUSPENSION OF WORK AND TERMINATION

Owner May Suspend Work:

15.1. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than ninety days by notice in writing to Contractor and Engineer which will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be allowed an adjustment in the Contract Price or an extension of the Contract Times, or both, directly

attributable to any such suspension if Contractor makes an approved claim therefore as provided in Articles 11 and 12.

15.2 Owner May Terminate:

Upon the occurrence of any one or more of the following events:

15.2.1. if Contractor persistently fails 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 established under paragraph 2.9 as adjusted from time to time pursuant to paragraph 6.6);

15.2.2. if Contractor disregards Laws or Regulations of any public body having jurisdiction;

15.2.3. if Contractor disregards the authority of Engineer; or

15.2.4. if Contractor otherwise violates in any substantial way any provisions of the Contract Documents;

15.2.5 *if Contractor commences a voluntary case under any chapter of the Bankruptcy Code (Title 11, United States Code), as now or hereafter in effect, or if Contractor takes any equivalent or similar action by filing a petition or otherwise under any other federal or state law in effect at such time relating to the bankruptcy or insolvency;*

15.2.6 *if a petition is filed against Contractor under any chapter of the Bankruptcy Code (Title 11, United States Code), as now or hereafter in effect at the time of filing, or if a petition is filed seeking any such equivalent or similar relief against Contractor under any other federal or state law in effect at the time relating to bankruptcy or insolvency;*

15.2.7 *if Contractor makes a general assignment for the benefit of creditors;*

15.2.8 *if a trustee, receiver, custodian, or agent of Contractor is appointed under applicable law or under contract, whose appointment or authority to take charge of property of Contractor is for the purpose of enforcing a Lien against such property or for the purpose of general administration of such property for the benefit of Contractor's creditors;*

15.2.9 *if Contractor admits in writing an inability to pay its debts generally as they become due.*

Owner may, after giving Contractor (and the surety, if any,) seven days' written notice and to the extent permitted by Laws and Regulations, terminate the services of Contractor, exclude Contractor from the site and take possession of the Work and of all Contractor's tools, appliances, construction equipment and machinery at the site and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion), 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 finish the Work as Owner may deem expedient. In such case Contractor shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds all claims, costs, losses and damages sustained by Owner arising out of or resulting from completing the Work such excess will be paid to Contractor. If such claims, costs, losses and damages exceed 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,

provided that when exercising any rights or remedies under this paragraph Owner shall not be required to obtain the lowest price for the Work performed.

15.3. 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. Any retention or payment of moneys due Contractor by Owner will not release Contractor from liability.

15.4. Upon seven days' written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, elect to terminate the Agreement. In such case, Contractor shall be paid (without duplication of any items):

15.4.1. for 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;

15.4.2. for 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;

15.4.3. for all claims, costs, losses and damages incurred in settlement of terminated contracts with Subcontractors, Suppliers and other; and

15.4.4. for reasonable expenses directly attributable to termination.

Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

15.5 Contractor May Stop Work or Terminate:

If, through no act or fault of Contractor, the Work is suspended for a period of more than ninety days by Owner or under an order of court or other public authority, or Engineer fails to act on any Application for Payment within thirty days after it is submitted or Owner fails for thirty days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days' written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the Agreement and recover from Owner payment on the same terms as provided in paragraph 15.4. In lieu of terminating the Agreement and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within thirty days after it is submitted, or Owner has failed for thirty days to pay Contractor any sum finally determined to be due, Contractor may upon seven day's written notice to Owner and Engineer stop the Work until payment of all such amounts due Contractor, including interest thereon. The provisions of this paragraph 15.5 are not intended to preclude Contractor from making claim under Articles 11 and 12 for an increase in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping Work as permitted by this paragraph.

ARTICLE 16- NOT USED

ARTICLE 17 – MISCELLANEOUS

17.1 Giving Notice:

Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if delivered in person to the individual or to a member of the firm or to an officer

of the corporation for whom it is intended, or if delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

17.2 Computation of Times:

17.2.1. When any period of time is referred to in the Contract Documents 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.

17.2.2. A calendar day of twenty-four hours measured from midnight to the next midnight will constitute a day.

17.3 Notice of Claim:

Should Owner or Contractor suffer injury or damage to person or property because of any error, omission or act of the other part or of any of the other party's employees or agents or others for whose acts the other party is legally liable, claim will be made in writing to the other party within a reasonable time of the first observance of such injury or damage. The provisions of this paragraph 17.3 shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitations or repose.

17.4 Cumulative Remedies:

The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto, and, in particular but without limitation, the warranties, guarantees and obligations imposed upon Contractor by paragraphs 6.12, 6.16, 6.30, 6.31, 6.32, 13.1, 13.12, 13.14, 14.3 and 15.2 and all of the rights and remedies available to Owner and Engineer thereunder, 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 Documents, and 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.

17.5 Professional Fees and Court Costs Included:

Whenever reference is made to "claims, costs, losses and damages," it shall include in each case, but not be limited to, all fees and charges of engineers, architects, attorneys and other professionals and all court or other dispute resolution costs.

~~17.6 Labor Records and Schedules:~~

~~The Department of Jurisdiction on such public work shall require all Contractors and Subcontractors to keep the following records on the site of the public work project on which such Contractors, and Subcontractors are engaged:~~

~~17.6.1 Record of hours worked by each worker, laborer, and mechanic on each day.~~

~~17.6.2 Record of days worked each week by each worker, laborer, and mechanic.~~

~~17.6.3 Schedule of occupation or occupations at which each worker, laborer, and mechanic on the project is employed during each workday and week.~~

~~17.6.4 Schedule of hourly wage rates and supplements paid to each worker, laborer, and mechanic for each occupation.~~

17.7 — Wage Schedules:

~~Pursuant to Sections 220.3 and 220 d of the Labor Law, each laborer, worker, or mechanic employed by the Contractor, Subcontractor, or other person shall be paid not less than the prevailing rate of wages for a legal day's work and shall be provided supplements not less than the prevailing supplements as determined by the Industrial Commissioner.~~

~~The Contractor and every Subcontractor shall post in a prominent and accessible place on the site of the work a legible statement of all wage rates and supplements as specified in the Contract to be paid or provided, as the case may be, for the various classes of mechanics, workers, and laborers employed on the work.~~

~~The Owner does not represent or warrant that the accompanying schedule of wage rates and supplements with the classification of workers, mechanics, and laborers, as required by Section 220 of the Labor Law, is complete, and it reserves the right to revise such schedule when required. If any occupation is not mentioned in the schedule of wage rates and supplements it shall be requested from the Industrial Commissioner, by the Contractor through the Engineer and such schedules, shall, upon notice to the Contractor, become and be a part of the wage and supplement schedules embodied in the Contract.~~

~~Also included is the Federal Wage Rate Determination. Laborers, workmen, and mechanics employed on the work done in performance of said Contract shall be paid not less than the rate of wages listed thereon for the trade or occupation of such laborer, etc.~~

GENERAL PROVISIONS

**BID DOCUMENTS
HANGAR DEVELOPMENTS
MARIANNA MUNICIPAL AIRPORT, MARIANNA, FLORIDA**

GENERAL PROVISIONS - SECTION 10

DEFINITION OF TERMS

Whenever the following terms are used in these specifications, in the contract, in any documents or other instruments pertaining to construction where these specifications govern, the intent and meaning shall be interpreted as follows:

10-01 AASHTO. The American Association of State Highway and Transportation Officials, the successor association to AASHO.

10-02 ACCESS ROAD. The right-of-way, the roadway and all improvements constructed thereon connecting the airport to a public highway.

10-03 ADVERTISEMENT. A public announcement, as required by local law, inviting bids for work to be performed and materials to be furnished.

10-04 AIP. The Airport Improvement Program, a grant-in-aid program, administered by the Federal Aviation Administration.

10-05 AIR OPERATIONS AREA. For the purpose of these specifications, the term air operations area shall mean any area of the airport used or intended to be used for the landing, takeoff, or surface maneuvering of aircraft. An air operation area shall include such paved or unpaved areas that are used or intended to be used for the unobstructed movement of aircraft in addition to its associated runway, taxiway, or apron.

10-06 AIRPORT. Airport means an area of land or water which is used or intended to be used for the landing and takeoff of aircraft, and includes its buildings and facilities, if any.

10-07 ASTM. The American Society for Testing and Materials.

10-08 AWARD. The acceptance, by the owner, of the successful contractor's proposal.

10-09 BUILDING AREA. An area on the airport to be used, considered, or intended to be used for airport buildings or other airport facilities or rights-of-way together with all airport buildings and facilities located thereon.

10-10 CALENDAR DAY. Every day shown on the calendar.

10-11 CHANGE ORDER. A written order to the Contractor covering changes in the plans, specifications, or proposal quantities and establishing the basis of payment and contract time adjustment, if any, for the work affected by such changes. The work, covered by a change order, shall be within the scope of the contract.

10-12 CONTRACT. The written agreement covering the work to be performed. The awarded contract shall include, but is not limited to: The Advertisement; The Contract Form; The Proposal; The Performance Bond; The Payment Bond; any required insurance certificates; The Specifications; The Plans, and any addenda issued to contractors.

10-13 CONTRACT ITEM (PAY ITEM). A specific unit of work for which a price is provided in the contract.

10-14 CONTRACT TIME. The number of calendar days or working days, stated in the proposal, allowed for completion of the contract, including authorized time extensions. If a calendar date of completion is stated in the proposal, in lieu of a number of calendar or working days, the contract shall be completed by that date.

10-15 CONTRACTOR. The individual, partnership, firm, or corporation primarily liable for the acceptable performance of the work contracted and for the payment of all legal debts pertaining to the work who acts directly or through lawful agents or employees to complete the contract work.

10-16 DRAINAGE SYSTEM. The system of pipes, ditches, and structures by which surface or subsurface waters are collected and conducted from the airport area.

10-17 ENGINEER. The individual, partnership, firm, or corporation duly authorized by the owner (sponsor) to be responsible for engineering supervision of the contract work and acting directly or through an authorized representative. *The following list of independent professional associates and consultants are considered the Owner's consultant for this Construction Contract:*

AVCON, Inc.
320 Bayshore Drive, Suite 'A'
Niceville, Florida 32578
Phone: (850) 678-0050

10-18 EQUIPMENT. All machinery, together with the necessary supplies for upkeep and maintenance, and also all tools and apparatus necessary for the proper construction and acceptable completion of the work.

10-19 EXTRA WORK. An item of work not provided for in the awarded contract as previously modified by change order or supplemental agreement, but which is found by the Engineer to be necessary to complete the work within the intended scope of the contract as previously modified.

10-20 FAA. The Federal Aviation Administration of the U.S. Department of Transportation. When used to designate a person, FAA shall mean the Administrator or his/her duly authorized representative.

10-21 FEDERAL SPECIFICATIONS. The Federal Specifications and Standards, and supplements, amendments, and indices thereto are prepared and issued by the General Services Administration of the Federal Government.

10-22 INSPECTOR. An authorized representative of the Engineer assigned to make all necessary inspections and/or tests of the work performed or being performed, or of the materials furnished or being furnished by the Contractor.

10-23 INTENTION OF TERMS. Whenever, in these specifications or on the plans, the words "directed," "required," "permitted," "ordered," "designated," "prescribed," or words of the like import are used, it shall be understood that the direction, requirement, permission, order, designation, or prescription of the Engineer is intended; and similarly, the words "approved," "acceptable," "satisfactory," or words of like import, shall mean approved by, or acceptable to, or satisfactory to the Engineer, subject in each case to the final determination of the owner.

Any reference to a specific requirement of a numbered paragraph of the contract specifications or a cited standard shall be interpreted to include all general requirements of the entire section, specification item, or cited standard that may be pertinent to such specific reference.

10-24 LABORATORY. The official testing laboratories of the owner or such other laboratories as may be designated by the Engineer.

10-25 LIGHTING. A system of fixtures providing or controlling the light sources used on or near the airport or within the airport buildings. The field lighting includes all luminous signals, markers, floodlights, and illuminating devices used on or near the airport or to aid in the operation of aircraft landing at, taking off from, or taxiing on the airport surface.

10-26 MAJOR AND MINOR CONTRACT ITEMS. A major contract item shall be any item that is listed in the proposal, the total cost of which is equal to or greater than 20 percent of the total amount of the award contract. All other items shall be considered minor contract items.

10-27 MATERIALS. Any substance specified for use in the construction of the contract work.

10-28 NOTICE TO PROCEED. A written notice to the Contractor to begin the actual contract work on a previously agreed to date. If applicable, the Notice to Proceed shall state the date on which the contract time begins.

10-29 OWNER (SPONSOR). The term owner shall mean the party of the first part or the contracting agency signatory to the contract. For AIP contracts, the term sponsor shall have the same meaning as the term owner.

10-30 PAVEMENT. The combined surface course, base course, and subbase course, if any, considered as a single unit.

10-31 PAYMENT BOND. The approved form of security furnished by the Contractor and his/her surety as a guaranty that he will pay in full all bills and accounts for materials and labor used in the construction of the work.

10-32 PERFORMANCE BOND. The approved form of security furnished by the Contractor and his/her surety as a guaranty that the Contractor will complete the work in accordance with the terms of the contract.

10-33 PLANS. The official drawings or exact reproductions which show the location, character, dimensions and details of the airport and the work to be done and which are to be considered as a part of the contract, supplementary to the specifications.

10-34 PROJECT. The agreed scope of work for accomplishing specific airport development with respect to a particular airport.

10-35 PROPOSAL. The written offer of the contractor (when submitted on the approved proposal form) to perform the contemplated work and furnish the necessary materials in accordance with the provisions of the plans and specifications.

10-36 PROPOSAL GUARANTY. The security furnished with a proposal to guarantee that the contractor will enter into a contract if his/her proposal is accepted by the owner.

10-37 RUNWAY. The area on the airport prepared for the landing and takeoff of aircraft.

10-38 SPECIFICATIONS. A part of the contract containing the written directions and requirements for completing the contract work. Standards for specifying materials or testing which are cited in the contract specifications by reference shall have the same force and effect as if included in the contract physically.

10-39 STRUCTURES. Airport facilities such as bridges; culverts; catch basins, inlets, retaining walls, cribbing; storm and sanitary sewer lines; water lines; underdrains; electrical ducts, manholes, handholes, lighting fixtures and bases; transformers; flexible and rigid pavements; navigational aids; buildings; vaults; and, other manmade features of the airport that may be encountered in the work and not otherwise classified herein.

10-40 SUBGRADE. The soil which forms the pavement foundation.

10-41 SUPERINTENDENT. The Contractor's executive representative who is present on the work during progress, authorized to receive and fulfill instructions from the Engineer, and who shall supervise and direct the construction.

10-42 SUPPLEMENTAL AGREEMENT. A written agreement between the Contractor and the owner covering: (1) work that would increase or decrease the total amount of the awarded contract, or any major contract item, by more than 25 percent, such increased or decreased work being within the scope of the originally awarded contract; or (2) work that is not within the scope of the originally awarded contract.

10-43 SURETY. The corporation, partnership, or individual, other than the Contractor, executing payment or performance bonds which are furnished to the owner by the Contractor.

10-44 TAXIWAY. For the purpose of this document, the term taxiway means the portion of the air operations area of an airport that has been designated by competent airport authority for movement of aircraft to and from the airport's runways or aircraft parking areas.

10-45 WORK. The furnishing of all labor, materials, tools, equipment, and incidentals necessary or convenient to the Contractor's performance of all duties and obligations imposed by the contract, plans, and specifications.

10-46 WORKING DAY. A working day shall be any day other than a legal holiday, Saturday, or Sunday on which the normal working forces of the Contractor may proceed with regular work for at least 6 hours toward completion of the contract. Unless work is suspended for causes beyond the Contractor's control, Saturdays, Sundays and holidays on which the Contractor's forces engage in regular work, requiring the presence of an inspector, will be considered as working days.

END OF SECTION 10

GENERAL PROVISIONS - SECTION 20

PROPOSAL REQUIREMENTS AND CONDITIONS

20-01 ADVERTISEMENT (Notice to Contractors). *Contractors shall refer to the Notice to Contractors (as amended) for the time and place for the project Pre-Bid Conference and the time and place for submitting sealed proposals.*

20-02 PREQUALIFICATION OF CONTRACTORS. Each contractor shall furnish the owner satisfactory evidence of his/her competency to perform the proposed work. Such evidence of competency, unless otherwise specified, shall consist of statements covering the contractor's past experience on similar work, a list of equipment that would be available for the work, and a list of key personnel that would be available. In addition, each contractor shall furnish the owner satisfactory evidence of his/her financial responsibility. Such evidence of financial responsibility, unless otherwise specified, shall consist of a confidential statement or report of the contractor's financial resources and liabilities as of the last calendar year or the Contractor's last fiscal year. Such statements or reports shall be certified by a public accountant. At the time of submitting such financial statements or reports, the contractor shall further certify whether his/her financial responsibility is approximately the same as stated or reported by the public accountant. If the contractor's financial responsibility has changed, the contractor shall qualify the public accountant's statement or report to reflect his/her (contractor's) true financial condition at the time such qualified statement or report is submitted to the owner.

Unless otherwise specified, a contractor may submit evidence that he is prequalified with the State Highway Division and is on the current "contractor's list" of the state in which the proposed work is located. Such evidence of State Highway Division prequalification may be submitted as evidence of financial responsibility in lieu of the certified statements or reports hereinbefore specified.

Each contractor shall submit "evidence of competency" and "evidence of financial responsibility" to the owner at the time of bid opening.

20-03 CONTENTS OF PROPOSAL FORMS. The owner shall furnish contractors with proposal forms. All papers bound with or attached to the proposal forms are necessary parts and must not be detached.

The plans specifications, and other documents designated in the proposal form shall be considered a part of the proposal whether attached or not.

20-04 ISSUANCE OF PROPOSAL FORMS. The owner reserves the right to refuse to issue a proposal form to a prospective contractor should such contractor be in default for any of the following reasons:

- a. Failure to comply with any prequalification regulations of the owner, if such regulations are cited, or otherwise included, in the proposal as a requirement for the bid.
- b. Failure to pay, or satisfactorily settle, all bills due for labor and materials on former contracts in force (with the owner) at the time the owner issues the proposal to a prospective contractor.
- c. Contractor default under previous contracts with the owner.
- d. Unsatisfactory work on previous contracts with the owner.

20-05 INTERPRETATION OF ESTIMATED PROPOSAL QUANTITIES. An estimate of quantities of work to be done and materials to be furnished under these specifications is given in the proposal. It is the result of careful calculations and is believed to be correct. It is given only as a basis for comparison of proposals and the award of the contract. The owner does not expressly or by implication agree that the actual quantities involved will correspond exactly therewith; nor shall the contractor plead misunderstanding or deception because of such estimates of quantities, or of the character, location, or other conditions pertaining to the work. Payment to the Contractor will be made only for the actual quantities of work performed or materials furnished in accordance with the plans and specifications. It is understood that the quantities may be increased or decreased as hereinafter provided in the subsection titled ALTERATION OF WORK AND QUANTITIES of Section 40 without in any way invalidating the unit bid prices.

20-06 EXAMINATION OF PLANS, SPECIFICATIONS, AND SITE. The contractor is expected to carefully examine the site of the proposed work, the proposal, plans specifications, and contract forms. He shall satisfy himself as to the character, quality, and quantities of work to be performed, materials to be furnished, and as to the requirements of the proposed contract. The submission of a proposal shall be prima facie evidence that the contractor has made such examination and is satisfied as to the conditions to be encountered in performing the work and as to the requirements of the proposed contract, plans, and specifications.

Boring logs and other records of subsurface investigations and tests are available for inspection of contractors. It is understood and agreed that such subsurface information, whether included in the plans, specifications, or otherwise made available to the contractor, was obtained and is intended for the owner's design and estimating purposes only. Such information has been made available for the convenience of all contractors. It is further understood and agreed that each contractor is solely responsible for all assumptions, deductions, or conclusions which he may make or obtain from his/her examination of the boring logs and other records of subsurface investigations and tests that are furnished by the owner.

20-07 PREPARATION OF PROPOSAL. The contractor shall submit his/her proposal on the forms furnished by the owner. All blank spaces in the proposal forms must be correctly filled in where indicated for each and every item for which a quantity is given. The contractor shall state the price (written in ink or typed) both in words and numerals for which he proposes to do each pay item furnished in the proposal. In case of conflict between words and numerals, the words, unless obviously incorrect, shall govern.

The contractor shall sign his/her proposal correctly and in ink. If the proposal is made by an individual, his/her name and post office address must be shown. If made by a partnership, the name and post office address of each member of the partnership must be shown. If made by a corporation, the person signing the proposal shall give the name of the state under the laws of which the corporation was chartered and the name, titles, and business address of the president, secretary, and the treasurer. Anyone signing a proposal as an agent shall file evidence of his/her authority to do so and that the signature is binding upon the firm or corporation.

20-08 IRREGULAR PROPOSALS. Proposals shall be considered irregular for the following reasons:

- a. If the proposal is on a form other than that furnished by the owner, or if the owner's form is altered, or if any part of the proposal form is detached.
- b. If there are unauthorized additions, conditional or alternate pay items, or irregularities of any kind which make the proposal incomplete, indefinite, or otherwise ambiguous.

- c. If the proposal does not contain a unit price for each pay item listed in the proposal, except in the case of authorized alternate pay items, for which the contractor is not required to furnish a unit price.
- d. If the proposal contains unit prices that are obviously unbalanced.
- e. If the proposal is not accompanied by the proposal guaranty specified by the owner.

The contractor must be a responsible party, i.e. it must have the required financial, managerial, technical, and ethical capacity to perform the contract. A bid that does not conform to all material terms and conditions of the Notice to Contractors that are deemed substantial shall be considered non-responsive.

The owner reserves the right to reject any irregular proposal and the right to waive technicalities if such waiver is in the best interest of the owner and conforms to local laws and ordinances pertaining to the letting of construction contracts.

20-09 BID GUARANTEE. Each separate proposal shall be accompanied by a certified check, or other specified acceptable collateral, in the amount specified in the proposal form. Such check, or collateral, shall be made payable to the owner.

20-10 DELIVERY OF PROPOSAL. Each proposal submitted shall be placed in a sealed envelope plainly marked with the project number, location of airport, and name and business address of the contractor on the outside. When sent by mail, preferably registered, the sealed proposal, marked as indicated above, should be enclosed in an additional envelope. No proposal will be considered unless received at the place specified in the advertisement before the time specified for opening all bids. Proposals received after the bid opening time shall be returned to the contractor unopened.

20-11 WITHDRAWAL OR REVISION OF PROPOSALS. A contractor may withdraw or revise (by withdrawal of one proposal and submission of another) a proposal provided that the contractor's request for withdrawal is received by the owner in writing or by telegram before the time specified for opening bids. Revised proposals must be received at the place specified in the advertisement before the time specified for opening all bids.

20-12 PUBLIC OPENING OF PROPOSALS. Proposals shall be opened, and read, publicly at the time and place specified in the advertisement. Contractors, their authorized agents, and other interested persons are invited to attend. Proposals that have been withdrawn (by written or telegraphic request) or received after the time specified for opening bids shall be returned to the contractor unopened.

20-13 DISQUALIFICATION OF CONTRACTORS. A contractor shall be considered disqualified for any of the following reasons:

- a. Submitting more than one proposal from the same partnership, firm, or corporation under the same or different name.
- b. Evidence of collusion among contractors. Contractors participating in such collusion shall be disqualified as contractors for any future work of the owner until any such participating contractor has been reinstated by the owner as a qualified contractor.

- c. If the contractor is considered to be in “default” for any reason specified in the subsection titled ISSUANCE OF PROPOSAL FORMS of this section.

END OF SECTION 20

GENERAL PROVISIONS - SECTION 30

AWARD AND EXECUTION OF CONTRACT

30-01 CONSIDERATION OF PROPOSALS. After the proposals are publicly opened and read, they will be compared on the basis of the summation of the products obtained by multiplying the estimated quantities shown in the proposal by the unit bid prices. If a contractor's proposal contains a discrepancy between unit bid prices written in words and unit bid prices written in numbers, the unit price written in words shall govern.

Until the award of a contract is made, the owner reserves the right to reject a contractor's proposal for any of the following reasons:

- a. If the proposal is irregular as specified in the subsection titled IRREGULAR PROPOSALS of Section 20.
- b. If the contractor is disqualified for any of the reasons specified in the subsection titled DISQUALIFICATION OF CONTRACTORS of Section 20.

In addition, until the award of a contract is made, the owner reserves the right to reject any or all proposals, waive technicalities, if such waiver is in the best interest of the owner and is in conformance with applicable state and local laws or regulations pertaining to the letting of construction contracts; advertise for new proposals; or proceed with the work otherwise. All such actions shall promote the owner's best interests.

30-02 AWARD OF CONTRACT. The award of a contract, if it is to be awarded, shall be made within 120 calendar days of the date specified for publicly opening proposals, unless otherwise specified herein.

Award of the contract shall be made by the owner to the lowest, qualified contractor whose proposal conforms to the cited requirements of the owner.

No award shall be made until the FAA has concurred in the Owner's recommendation to make such award and has approved the Owner's proposed contract to the extent that such concurrence and approval are required by 49 CFR Part 18.

30-03 CANCELLATION OF AWARD. The owner reserves the right to cancel the award without liability to the contractor, except return of proposal guaranty, at any time before a contract has been fully executed by all parties and is approved by the owner in accordance with the subsection titled APPROVAL OF CONTRACT of this section.

30-04 RETURN OF PROPOSAL GUARANTY. All proposal guaranties, except those of the two lowest contractors, will be returned immediately after the owner has made a comparison of bids as herein before specified in the subsection titled CONSIDERATION OF PROPOSALS of this section. Proposal guaranties of the two lowest contractors will be retained by the owner until such time as an award is made, at which time, the unsuccessful contractor's proposal guaranty will be returned. The successful contractor's proposal guaranty will be returned as soon as the owner receives the contracts bonds as specified in the subsection titled REQUIREMENTS OF CONTRACT BONDS of this section.

30-05 REQUIREMENTS OF CONTRACT BONDS. At the time of the execution of the contract, the successful contractor shall furnish the owner a surety bond or bonds which have been fully executed by the contractor and the surety guaranteeing the performance of the work and the payment of all legal debts that may be incurred by reason of the Contractor's performance of the work. The surety and the form of the bond or bonds shall be acceptable to the owner. Unless otherwise specified in this subsection, the surety bond or bonds shall be in a sum equal to the full amount of the contract.

30-06 EXECUTION OF CONTRACT. The successful contractor shall sign (execute) the necessary agreements for entering into the contract and return such signed contract to the owner, along with the fully executed surety bond or bonds specified in the subsection titled REQUIREMENTS OF CONTRACT BONDS of this section, within 15 calendar days from the date mailed or otherwise delivered to the successful contractor. If the contract is mailed, special handling is recommended.

The Contractor and all sub-recipients or subcontractors under this contract shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. Failure of the Contractor to carry out the applicable requirements of 49 CFR Part 26 in the award and administration of these requirements is a material breach of this contract, which may result in the termination of this contract.

30-07 APPROVAL OF CONTRACT. Upon receipt of the contract and contract bond or bonds that have been executed by the successful contractor, the owner shall complete the execution of the contract in accordance with local laws or ordinances, and return the fully executed contract to the Contractor. Delivery of the fully executed contract to the Contractor shall constitute the owner's approval to be bound by the successful contractor's proposal and the terms of the contract.

30-08 FAILURE TO EXECUTE CONTRACT. Failure of the successful contractor to execute the contract and furnish an acceptable surety bond or bonds within the 15 calendar day period specified in the subsection titled REQUIREMENTS OF CONTRACT BONDS of this section shall be just cause for cancellation of the award and forfeiture of the proposal guaranty, not as a penalty, but as liquidation of damages to the owner.

END OF SECTION 30

GENERAL PROVISIONS - SECTION 40

SCOPE OF WORK

40-01 INTENT OF CONTRACT. The intent of the contract is to provide for construction and completion, in every detail, of the work described. It is further intended that the Contractor shall furnish all labor, materials, equipment, tools, transportation, and supplies required to complete the work in accordance with the plans, specifications, and terms of the contract.

40-02 ALTERATION OF WORK AND QUANTITIES. The owner reserves and shall have the right to make such alterations in the work as may be necessary or desirable to complete the work originally intended in an acceptable manner. Unless otherwise specified herein, the Engineer shall be and is hereby authorized to make such alterations in the work as may increase or decrease the originally awarded contract quantities, provided that the aggregate of such alterations does not change the total contract cost or the total cost of any major contract item by more than 25 percent (total cost being based on the unit prices and estimated quantities in the awarded contract). Alterations which do not exceed the 25 percent limitation shall not invalidate the contract nor release the surety, and the Contractor agrees to accept payment for such alterations as if the altered work had been a part of the original contract. These alterations which are for work within the general scope of the contract shall be covered by "Change Orders" issued by the Engineer. Change orders for altered work shall include extensions of contract time where, in the Engineer's opinion, such extensions are commensurate with the amount and difficulty of added work.

Should the aggregate amount of altered work exceed the 25 percent limitation hereinbefore specified, such excess altered work shall be covered by supplemental agreement. If the owner and the Contractor are unable to agree on a unit adjustment for any contract item that requires a supplemental agreement, the owner reserves the right to terminate the contract with respect to the item and make other arrangements for its completion.

All supplemental agreements shall be approved by the FAA or FDOT, as applicable, and shall include valid wage determinations of the U.S. Secretary of Labor when the amount of the supplemental agreement exceeds \$2,000. However, if the Contractor elects to waive the limitations on work that increases or decreases the originally awarded contract or any major contract item by more than 25 percent, the supplemental agreement shall be subject to the same U.S. Secretary of Labor wage determination as was included in the originally awarded contract.

All supplemental agreements shall require consent of the Contractor's surety and separate performance and payment bonds.

40-03 OMITTED ITEMS. The Engineer may, in the owner's best interest, omit from the work any contract item, except major contract items. Major contract items may be omitted by a supplemental agreement. Such omission of contract items shall not invalidate any other contract provision or requirement.

Should a contract item be omitted or otherwise ordered to be non-performed, the Contractor shall be paid for all work performed toward completion of such item prior to the date of the order to omit such item. Payment for work performed shall be in accordance with the subsection titled PAYMENT FOR OMITTED ITEMS of Section 90.

40-04 EXTRA WORK. Should acceptable completion of the contract require the Contractor to perform an item of work for which no basis of payment has been provided in the original contract or previously issued change orders or supplemental agreements, the same shall be called Extra Work. Extra work that is within the general scope of the contract shall be covered by written change order. Change orders for such extra work shall contain agreed unit prices for performing the change order work in accordance with the requirements specified in the order, and shall contain any adjustment to the contract time that, in the Engineer's opinion, is necessary for completion of such extra work.

When determined by the Engineer to be in the owner's best interest, he may order the Contractor to proceed with extra work by force account as provided in the subsection titled PAYMENT FOR EXTRA AND FORCE ACCOUNT WORK of Section 90.

Extra work that is necessary for acceptable completion of the project, but is not within the general scope of the work covered by the original contract shall be covered by a Supplemental Agreement as hereinbefore defined in the subsection titled SUPPLEMENTAL AGREEMENT of Section 10.

Any claim for payment of extra work that is not covered by written agreement (change order or supplemental agreement) shall be rejected by the owner.

40-05 MAINTENANCE OF TRAFFIC. It is the explicit intention of the contract that the safety of aircraft, as well as the Contractor's equipment and personnel, is the most important consideration. It is understood and agreed that the Contractor shall provide for the free and unobstructed movement of aircraft in the air operations areas of the airport with respect to his/her own operations and the operations of all his/her subcontractors as specified in the subsection titled LIMITATION OF OPERATIONS of Section 80. It is further understood and agreed that the Contractor shall provide for the uninterrupted operation of visual and electronic signals (including power supplies thereto) used in the guidance of aircraft while operating to, from, and upon the airport as specified in the subsection titled CONTRACTOR'S RESPONSIBILITY FOR UTILITY SERVICE AND FACILITIES OF OTHERS in Section 70.

With respect to his/her own operations and the operations of all his/her subcontractors, the Contractor shall provide marking, lighting, and other acceptable means of identifying: personnel; equipment; vehicles; storage areas; and any work area or condition that may be hazardous to the operation of aircraft, fire-rescue equipment, or maintenance vehicles at the airport.

When the contract requires the maintenance of vehicular traffic on an existing road, street, or highway during the Contractor's performance of work that is otherwise provided for in the contract, plans, and specifications, the Contractor shall keep such road, street, or highway open to all traffic and shall provide such maintenance as may be required to accommodate traffic. The Contractor shall furnish erect, and maintain barricades, warning signs, flagmen, and other traffic control devices in reasonable conformity with the manual of Uniform Traffic Control Devices for Streets and Highways (published by the United States Government Printing Office), unless otherwise specified herein. The Contractor shall also construct and maintain in a safe condition any temporary connections necessary for ingress to and egress from abutting property or intersecting roads, streets or highways. Unless otherwise specified herein, the Contractor will not be required to furnish snow removal for such existing road, street, or highway.

The Contractor shall make his/her own estimate of all labor, materials, equipment, and incidentals necessary for providing the maintenance of aircraft and vehicular traffic as specified in this subsection.

The cost of maintaining the aircraft and vehicular traffic specified in this subsection shall not be measured or paid for directly, but shall be included in the various contract items.

40-06 REMOVAL OF EXISTING STRUCTURES. All existing structures encountered within the established lines, grades, or grading sections shall be removed by the Contractor, unless such existing structures are otherwise specified to be relocated, adjusted up or down, salvaged, abandoned in place, reused in the work or to remain in place. The cost of removing such existing structures shall not be measured or paid for directly, but shall be included in the various contract items.

Should the Contractor encounter an existing structure (above or below ground) in the work for which the disposition is not indicated on the plans, the Engineer shall be notified prior to disturbing such structure. The disposition of existing structures so encountered shall be immediately determined by the Engineer in accordance with the provisions of the contract.

Except as provided in the subsection titled RIGHTS IN AND USE OF MATERIALS FOUND IN THE WORK of this section, it is intended that all existing materials or structures that may be encountered (within the lines, grades, or grading sections established for completion of the work) shall be utilized in the work as otherwise provided for in the contract and shall remain the property of the owner when so utilized in the work.

40-07 RIGHTS IN AND USE OF MATERIALS FOUND IN THE WORK. Should the Contractor encounter any material such as (but not restricted to) sand, stone, gravel, slag, or concrete slabs within the established lines, grades, or grading sections, the use of which is intended by the terms of the contract to be either embankment or waste, he may at his/her option either:

- a. Use such material in another contract item, providing such use is approved by the Engineer and is in conformance with the contract specifications applicable to such use; or,
- b. Remove such material from the site, upon written approval of the Engineer; or
- c. Use such material for his/her own temporary construction on site; or,
- d. Use such material as intended by the terms of the contract.

Should the Contractor wish to exercise option a., b., or c., he shall request the Engineer's approval in advance of such use.

Should the Engineer approve the Contractor's request to exercise option a., b., or c., the Contractor shall be paid for the excavation or removal of such material at the applicable contract price. The Contractor shall replace, at his/her own expense, such removed or excavated material with an agreed equal volume of material that is acceptable for use in constructing embankment, backfills, or otherwise to the extent that such replacement material is needed to complete the contract work. The Contractor shall not be charged for his/her use of such material so used in the work or removed from the site.

Should the Engineer approve the Contractor's exercise of option a., the Contractor shall be paid, at the applicable contract price, for furnishing and installing such material in accordance with requirements of the contract item in which the material is used.

It is understood and agreed that the Contractor shall make no claim for delays by reason of his/her exercise of option a., b., or c.

The Contractor shall not excavate, remove, or otherwise disturb any material, structure, or part of a structure which is located outside the lines, grades, or grading sections established for the work, except where such excavation or removal is provided for in the contract, plans, or specifications.

40-08 FINAL CLEANING UP. Upon completion of the work and before acceptance and final payment will be made, the Contractor shall remove from the site all machinery, equipment, surplus and discarded materials, rubbish, temporary structures, and stumps or portions of trees. He shall cut all brush and woods within the limits indicated and shall leave the site in a neat and presentable condition. Material cleared from the site and deposited on adjacent property will not be considered as having been disposed of satisfactorily, unless the Contractor has obtained the written permission of such property owner.

END OF SECTION 40

GENERAL PROVISIONS - SECTION 50

CONTROL OF WORK

50-01 AUTHORITY OF THE ENGINEER. The Engineer shall decide any and all questions which may arise as to the quality and acceptability of materials furnished, work performed, and as to the manner of performance and rate of progress of the work. He shall decide all questions which may arise as to the interpretation of the specifications or plans relating to the work, the fulfillment of the contract on the part of the Contractor, and the rights of different Contractors on the project. The Engineer shall determine the amount and quality of the several kinds of work performed and materials furnished which are to be paid for the under contract.

50-02 CONFORMITY WITH PLANS AND SPECIFICATIONS. All work and all materials furnished shall be in reasonably close conformity with the lines, grades, grading sections, cross sections, dimensions, material requirements, and testing requirements that are specified (including specified tolerances) in the contract, plans or specifications.

If the Engineer finds the materials furnished, work performed, or the finished product not within reasonably close conformity with the plans and specifications but that the portion of the work affected will, in his/her opinion, result in a finished product having a level of safety, economy, durability, and workmanship acceptable to the owner, he will advise the owner of his/her determination that the affected work be accepted and remain in place. In this event, the Engineer will document his/her determination and recommend to the owner a basis of acceptance which will provide for an adjustment in the contract price for the affected portion of the work. The Engineer's determination and recommended contract price adjustments will be based on good engineering judgment and such tests or retests of the affected work as are, in his/her opinion, needed. Changes in the contract price shall be covered by contract modifications (change order or supplemental agreement) as applicable.

If the Engineer finds the materials furnished, work performed, or the finished product are not in reasonably close conformity with the plans and specifications and have resulted in an unacceptable finished product, the affected work or materials shall be removed and replaced or otherwise corrected by and at the expense of the Contractor in accordance with the Engineer's written orders.

For the purpose of this subsection, the term "reasonably close conformity" shall not be construed as waiving the Contractor's responsibility to complete the work in accordance with the contract, plans, and specifications. The term shall not be construed as waiving the Engineer's right to insist on strict compliance with the requirements of the contract, plans, and specifications during the Contractor's prosecution of the work, when, in the Engineer's opinion, such compliance is essential to provide an acceptable finished portion of the work.

For the purpose of this subsection, the term "reasonably close conformity" is also intended to provide the Engineer with the authority to use good engineering judgment in his/her determinations as to acceptance of work that is not in strict conformity but will provide a finished product equal to or better than that intended by the requirements of the contract, plans and specifications.

The Engineer should advise the Owner if her/she accepts work that is not in "reasonably close conformity" to the Contract, Plans and Specifications. The Owner will in turn advise the FAA. Change orders or supplemental agreements for AIP contracts must bear the written approval of the FAA.

50-03 COORDINATION OF CONTRACT, PLANS, AND SPECIFICATIONS. The contract, plans, specifications, and all referenced standards cited are essential parts of the contract requirements. A requirement occurring in one is as binding as though occurring in all. They are intended to be complementary and to describe and provide for a complete work. In case of discrepancy, calculated dimensions will govern over scaled dimensions; contract technical specifications shall govern over contract general provisions, plans, cited standards for materials or testing, and cited FAA advisory circulars; contract general provisions shall govern over plans, cited standards for materials or testing, and cited FAA advisory circulars; plans shall govern over cited standards for materials or testing and cited FAA advisory circulars. If any paragraphs contained in the Special Provisions conflict with General Provisions or Technical Specifications, the Special Provisions shall govern.

The Contractor shall not take advantage of any apparent error or omission on the plans or specifications. In the event the Contractor discovers any apparent error or discrepancy, he shall immediately call upon the Engineer for his/her interpretation and decision, and such decision shall be final.

50-04 COOPERATION OF CONTRACTOR. The Contractor will be supplied with two copies each of the plans and specifications. He shall have available on the worksite at all times, one copy each of the plans and specifications. Additional copies of plans and specifications may be obtained by the Contractor for the cost of reproduction.

The Contractor shall give constant attention to the work to facilitate the progress thereof, and he shall cooperate with the Engineer and his/her inspectors and with other contractors in every way possible. The Engineer shall allocate the work and designate the sequence of construction in case of controversy between contractors. The Contractor shall have a competent superintendent on the work at all times who is fully authorized as his/her agent on the work. The superintendent shall be capable of reading and thoroughly understanding the plans and specifications and shall receive and fulfill instructions from the Engineer or his/her authorized representative.

50-05 COOPERATION BETWEEN CONTRACTORS. The owner reserves the right to contract for and perform other or additional work on or near the work covered by this contract.

When separate contracts are let within the limits of any one project, each Contractor shall conduct his/her work so as not to interfere with or hinder the progress of completion of the work being performed by other Contractors. Contractors working on the same project shall cooperate with each other as directed.

Each Contractor involved shall assume all liability, financial or otherwise, in connection with his/her contract and shall protect and save harmless the owner from any and all damages or claims that may arise because of inconvenience, delays, or loss experienced by him because of the presence and operations of other Contractors working within the limits of the same project.

The Contractor shall arrange his/her work and shall place and dispose of the materials being used so as not to interfere with the operations of the other Contractors within the limits of the same project. He shall join his/her work with that of the others in an acceptable manner and shall perform it in proper sequence to that of the others.

50-06 CONSTRUCTION LAYOUT AND STAKES. The Engineer shall establish horizontal and vertical control only. The Contractor must establish all layout required for the construction of the work. Such stakes and markings as the Engineer may set for either his/her own or the Contractor's guidance shall be preserved by the Contractor. In case of negligence on the part of the Contractor, or his/her employees, resulting in

the destruction of such stakes or markings, an amount equal to the cost of replacing the same may be deducted from subsequent estimates due the Contractor at the discretion of the Engineer.

The Contractor will be required to furnish all lines, grades and measurements from the control points necessary for the proper prosecution and control of the work contracted for under these specifications.

The Contractor must give weekly copies of the survey notes to the Engineer so that the Engineer may check them as to accuracy and method of staking. All areas that are staked by the Contractor must be checked by the Engineer prior to beginning any work in the area. The Engineer will make periodic checks of the grades and alignment set by the Contractor. In case of error on the part of the Contractor, or his/her employees, resulting in establishing grades and/or alignment that are not in accordance with the plans or established by the Engineer, all construction not in accordance with the established grades and/or alignment shall be replaced without additional cost to the Owner.

No direct payment will be made, unless otherwise specified in contract documents, for this labor, materials, or other expenses therewith. The cost thereof shall be included in the price of the bid for the various items of the Contract. Construction Staking and Layout includes but is not limited to:

Clearing and Grubbing perimeter staking.

Rough Grade slope stakes at 100-foot stations.

Drainage Swales slope stakes and flow line blue tops at 50-foot stations.

Subgrade blue tops at 25 foot stations and 25 foot offset distance (max.) for the following section locations:

- a. Runway – minimum 5 per station
- b. Taxiways – minimum 3 per station
- c. Holding apron areas – minimum 3 per station
- d. Roadways – minimum 3 per station

Base Course blue tops at 25 foot stations and 25 foot offset distance (max.) for the following section locations:

- a. Runway – minimum 5 per station
- b. Taxiways – minimum 3 per station
- c. Holding apron areas – minimum 3 per station

Pavement areas:

- a. Edge of Pavement hubs and tacks (for stringline by Contractor) at 100 foot stations
- b. Between Lifts at 25 foot stations for the following section locations:

- (1) Runways – each paving lane width
 - (2) Taxiways – each paving lane width
 - (3) Holding areas – each paving lane width
- c. After finish paving operations at 50 foot stations
- (1) All paved areas – Edge of each paving lane prior to next paving lot
- d. Shoulder and safety area blue tops at 50 foot stations and at all break points with maximum of 50 foot offsets

Fence lines at 100 foot stations

Electrical and Communications System locations, lines and grades including but not limited to duct runs, connections, fixtures, signs, lights, VASI's, PAPI's, REIL's, Wind Cones, Distance Markers (signs), pull boxes and manholes.

Drain lines, cut stakes and alignment on 25-foot stations, inlet and manholes.

Painting and Striping layout (pinned with 1.5 inch PK nails) marked for paint Contractor. (All nails shall be removed after painting)

Laser, or other automatic control devices, shall be checked with temporary control point or grade hub at a minimum of once per 400 feet per pass (i.e. paving lane).

NOTE: Controls and stakes disturbed or suspect of having been disturbed shall be checked and/or reset as directed by the Engineer without additional cost to the Owner.

50-07 AUTOMATICALLY CONTROLLED EQUIPMENT. Whenever batching or mixing plant equipment is required to be operated automatically under the contract and a breakdown or malfunction of the automatic controls occurs, the equipment may be operated manually or by other methods for a period 48 hours following the breakdown or malfunction, provided this method of operations will product results which conform to all other requirements of the contract.

50-08 AUTHORITY AND DUTIES OF INSPECTORS. Inspectors employed by the owner shall be authorized to inspect all work done and all material furnished. Such inspection may extend to all or any part of the work and to the preparation, fabrication, or manufacture of the materials to be used. Inspectors are not authorized to revoke, alter, or waive any provision of the contract. Inspectors are not authorized to issue instructions contrary to the plans and specifications or to act as foreman for the Contractor.

Inspectors employed by the owner are authorized to notify the Contractor or his/her representatives of any failure of the work or materials to conform to the requirements of the contract, plans, or specifications and to reject such nonconforming materials in question until such issues can be referred to the Engineer for his/her decision.

50-09 INSPECTION OF THE WORK. All materials and each part or detail of the work shall be subject to inspection by the Engineer. The Engineer shall be allowed access to all parts of the work and shall be

furnished with such information and assistance by the Contractor as is required to make a complete and detailed inspection.

If the Engineer requests it, the Contractor, at any time before acceptance of the work, shall remove or uncover such portions of the finished work as may be directed. After examination, the Contractor shall restore said portions of the work to the standard required by the specifications. Should the work thus exposed or examined prove acceptable, the uncovering, or removing, and the replacing of the covering or making good of the parts removed will be paid for as extra work; but should the work so exposed or examined prove unacceptable, the uncovering, or removing, and the replacing of the covering or making good of the parts removed will be at the Contractor's expense.

Any work done or materials used without supervision or inspection by an authorized representative of the owner may be ordered removed and replaced at the Contractor's expense unless the owner's representative failed to inspect after having been given reasonable notice in writing that the work was to be performed.

Should the contract work include relocation, adjustment, or any other modification to existing facilities, not the property of the (contract) owner, authorized representatives of the owners of such facilities shall have the right to inspect such work. Such inspection shall in no sense make any facility owner a party to the contract, and shall in no way interfere with the rights of the parties to this contract.

50-10 REMOVAL OF UNACCEPTABLE AND UNAUTHORIZED WORK. All work which does not form to the requirements of the contract, plans, and specifications will be considered unacceptable, unless otherwise determined acceptable by the Engineer as provided in the subsection titled CONFORMITY WITH PLANS AND SPECIFICATIONS of this section.

Unacceptable work, whether the result of poor workmanship, use of defective materials, damage through carelessness, or any other cause found to exist prior to the final acceptance of the work, shall be removed immediately and replaced in an acceptable manner in accordance with the provisions of the subsection titled CONTRACTOR'S RESPONSIBILITY FOR WORK of Section 70.

Work done contrary to the instructions of the Engineer, work done beyond the lines shown on the plans or as given, except as herein specified, or any extra work done without authority, will be considered as unauthorized and will not be paid for under the provisions of the contract. Work so done may be ordered removed or replaced at the Contractor's expense.

Upon failure on the part of the Contractor to comply forthwith with any order of the Engineer made under the provisions of this subsection, the Engineer will have authority to cause unacceptable work to be remedied or removed and replaced and unauthorized work to be removed and to deduct the costs (incurred by the owner) from any monies due or to become due the Contractor.

50-11 LOAD RESTRICTIONS. The Contractor shall comply with all legal load restrictions in the hauling of materials on public roads beyond the limits of the work. A special permit will not relieve the Contractor of liability for damage which may result from the moving of material or equipment.

The operation of equipment of such weight or so loaded as to cause damage to structures or to any other type of construction will not be permitted. Hauling of materials over the base course or surface course under construction shall be limited as directed. No loads will be permitted on a concrete pavement, base,

or structure before the expiration of the curing period. The Contractor shall be responsible for all damage done by his/her hauling equipment and shall correct such damage at his/her own expense.

50-12 MAINTENANCE DURING CONSTRUCTION. The Contractor shall maintain the work during construction and until the work is accepted. This maintenance shall constitute continuous and effective work prosecuted day by day, with adequate equipment and forces so that the work is maintained in satisfactory condition at all times.

In the case of a contract for the placing of a course upon a course or subgrade previously constructed, the Contractor shall maintain the previous course or subgrade during all construction operations.

All costs of maintenance work during construction and before the project is accepted shall be included in the unit prices bid on the various contract items, and the Contractor will not be paid an additional amount for such work.

50-13 FAILURE TO MAINTAIN THE WORK. Should the Contractor at any time fail to maintain the work as provided in the subsection titled MAINTENANCE DURING CONSTRUCTION of this section, the Engineer shall immediately notify the Contractor of such noncompliance. Such notification shall specify a reasonable time within which the Contractor shall be required to remedy such unsatisfactory maintenance condition. The time specified will give due consideration to the exigency that exists.

Should the Contractor fail to respond to the Engineer's notification, the Engineer may suspend any work necessary for the owner to correct such unsatisfactory maintenance condition, depending on the exigency that exists. Any maintenance cost incurred by the owner, shall be deducted from monies due or to become due the Contractor.

50-14 PARTIAL ACCEPTANCE. If at any time during the prosecution of the project the Contractor substantially completes a usable unit or portion of the work, the occupancy of which will benefit the owner, he may request the Engineer to make final inspection of that unit. If the Engineer finds upon inspection that the unit has been satisfactorily completed in compliance with the contract, he may accept it as being completed, and the Contractor may be relieved of further responsibility for that unit. Such partial acceptance and beneficial occupancy by the owner shall not void or alter any provision of the contract.

50-15 FINAL ACCEPTANCE. Upon due notice from the Contractor of presumptive completion of the entire project, the Engineer and owner will make an inspection. If all construction provided for and contemplated by the contract is found to be completed in accordance with the contract, plans, and specifications, such inspection shall constitute the final inspection. The Engineer shall notify the Contractor in writing of final acceptance as of the date of the final inspection.

If, however, the inspection discloses any work, in whole or in part, as being unsatisfactory, the Engineer will give the Contractor the necessary instructions for correction of same and the Contractor shall immediately comply with and execute such instructions. Upon correction of the work, another inspection will be made which shall constitute the final inspection, provided the work has been satisfactorily completed. In such event, the Engineer will make the final acceptance and notify the Contractor in writing of this acceptance as of the date of final inspection.

50-16 CLAIMS FOR ADJUSTMENT AND DISPUTES. If for any reason the Contractor deems that additional compensation is due him for work or materials not clearly provided for in the contract, plans, or

specifications or previously authorized as extra work, he shall notify the Engineer in writing of his/her intention to claim such additional compensation before he begins the work on which he bases the claim. If such notification is not given or the Engineer is not afforded proper opportunity by the Contractor for keeping strict account of actual cost as required, then the Contractor hereby agrees to waive any claim for such additional compensation. Such notice by the Contractor and the fact that the Engineer has kept account of the cost of the work shall not in any way be construed as proving or substantiating the validity of the claim. When the work on which the claim for additional compensation is based has been completed, the Contractor shall, within 10 calendar days, submit his/her written claim to the Engineer who will present it to the owner for consideration in accordance with local laws or ordinances.

Nothing in this subsection shall be construed as a waiver of the Contractor's right to dispute final payment based on differences in measurements or computations.

50-17 COST REDUCTION INCENTIVE. The provisions of this subsection will apply only to contracts awarded to the lowest contractor pursuant to competitive bids.

On projects with original contract amounts in excess of \$100,000, the Contractor may submit to the Engineer, in writing, proposals for modifying the plans, specifications or other requirements of the contract for the sole purpose of reducing the cost of construction. The cost reduction proposal shall not impair, in any manner, the essential functions or characteristics of the project, including but not limited to service life, economy of operation, ease of maintenance, desired appearance, design and safety standards. This provision shall not apply unless the proposal submitted is specifically identified by the Contractor as being presented for consideration as a value engineering proposal.

Not eligible for cost reduction proposals are changes in the basic design of a pavement type, runway and taxiway lighting, visual aids, hydraulic capacity of drainage facilities, or changes in grade or alignment that reduce the geometric standards of the project.

As a minimum, the following information shall be submitted by the Contractor with each proposal:

- a. A description of both existing contract requirements for performing the work and the proposed changes, with a discussion of the comparative advantages and disadvantages of each;
- b. An itemization of the contract requirements that must be changed if the proposal is adopted;
- c. A detailed estimate of the cost of performing the work under the existing contract and under the proposed changes;
- d. A statement of the time by which a change order adopting the proposal must be issued;
- e. A statement of the effect adoption of the proposal will have on the time for completion of the contract; and
- f. The contract items of work affected by the proposed changes, including any quantity variation attributable to them.

The Contractor may withdraw, in whole or in part, any cost reduction proposal not accepted by the Engineer, within the period specified in the proposal. The provisions of this subsection shall not be construed to require the Engineer to consider any cost reduction proposal which may be submitted.

The Contractor shall continue to perform the work in accordance with the requirements of the contract until a change order incorporating the cost reduction proposal has been issued. If a change order has not been issued by the date upon which the Contractor's cost reduction proposal specifies that a decision should be made, or such other date as the Contractor may subsequently have requested in writing, such cost reduction proposal shall be deemed rejected.

The Engineer shall be the sole judge of the acceptability of a cost reduction proposal and of the estimated net savings from the adoption of all or any part of such proposal. In determining the estimated net savings, the Engineer may disregard the contract bid prices if, in the Engineer's judgment such prices do not represent a fair measure of the value of the work to be performed or deleted.

The owner may require the Contractor to share in the owner's costs of investigating a cost reduction proposal submitted by the Contractor as a condition of considering such proposal. Where such a condition is imposed, the Contractor shall acknowledge acceptance of it in writing. Such acceptance shall constitute full authority for the owner to deduct the cost of investigating a cost reduction proposal from amounts payable to the Contractor under the contract.

If the Contractor's cost reduction proposal is accepted in whole or in part, such acceptance will be by a contract change order which shall specifically state that it is executed pursuant to this subsection. Such change order shall incorporate the changes in the plans and specifications which are necessary to permit the cost reduction proposal or such part of it as has been accepted and shall include any conditions upon which the Engineer's approval is based. The change order shall also set forth the estimated net savings attributable to the cost reduction proposal. The net savings shall be determined as the difference in costs between the original contract costs for the involved work items and the costs occurring as a result of the proposed change. The change order shall also establish the net savings agreed upon and shall provide for adjustment in the contract price that will divide the net savings equally between the Contractor and the Owner.

The Contractor's 50 percent share of the net savings shall constitute full compensation to the Contractor for the cost reduction proposal and the performance of the work.

Acceptance of the cost-reduction proposal and performance of the cost-reduction work shall not extend the time of completion of the contract unless specifically provided for in the contract change order.

END OF SECTION 50

GENERAL PROVISIONS - SECTION 60

CONTROL OF MATERIALS

60-01 SOURCE OF SUPPLY AND QUALITY REQUIREMENTS. The materials used on the work shall conform to the requirements of the contract, plans, and specifications. Unless otherwise specified, such materials that are manufactured or processed shall be new (as compared to used or reprocessed).

In order to expedite the inspection and testing of materials, the Contractor shall furnish complete statements to the Engineer as to the origin, composition, and manufacture of all materials to be used in the work. Such statements shall be furnished promptly after execution of the contract but, in all cases, prior to delivery of such materials.

At the Engineer's option, materials may be approved at the source of supply before delivery is stated. If it is found after trial that sources of supply for previously approved materials do not produce specified products, the Contractor shall furnish materials from other sources.

The Contractor shall furnish airport lighting equipment that conforms to the requirements of cited materials specifications. In addition, where an FAA specification for airport lighting equipment is cited in the plans or specifications, the Contractor shall furnish such equipment that is:

- a. Listed in FAA Advisory Circular (AC) 150/5345-1, Approved Airport Equipment, that is in effect on the date of advertisement; and,
- b. Produced by the manufacturer qualified (by FAA) to produce such specified and listed equipment.

The following airport lighting equipment is required for this contract and is to be furnished by the Contractor in accordance with the requirements of this subsection:

Bid Item	Item Description
	None

60-02 SAMPLES, TESTS, AND CITED SPECIFICATIONS. Unless otherwise designated, all materials used in the work shall be inspected, tested, and approved by the Engineer before incorporation in the work. Any work in which untested materials are used without approval or written permission of the Engineer shall be performed at the Contractor's risk. Materials found to be unacceptable and unauthorized will not be paid for and, if directed by the Engineer, shall be removed at the Contractor's expense. Unless otherwise designated, tests in accordance with the cited standard methods of ASTM, AASHTO, Federal Specifications, Commercial Item Descriptions, and all other cited methods, which are current on the date

of advertisement for bids, will be made by and at the expense of the Engineer. The testing organizations performing on site field tests shall have copies of all referenced standards on the construction site for use by all technicians and other personnel, including the Contractor's representative at his/her request. Unless otherwise designated, samples will be taken by a qualified representative of the Engineer. All materials being used are subject to inspection, test, or rejection at any time prior to or during incorporation into the work. Copies of all tests will be furnished to the Contractor's representative at his/her request.

The Contractor shall employ a testing organization to perform all Contractor required tests. The Contractor shall submit to the Engineer resumes on all testing organizations and individual persons who will be performing the tests. The Engineer will determine if such persons are qualified. All the test data shall be reported to the Engineer after the results are known. A legible, handwritten copy of all test data shall be given to the Engineer daily, along with printed reports, in an approved format, on a weekly basis. After completion of the project, and prior to final payment, the Contractor shall submit a final report to the Engineer showing all test data reports, plus an analysis of all results showing ranges, averages, and corrective action taken on all failing tests.

60-03 CERTIFICATION OF COMPLIANCE. The Engineer may permit the use, prior to sampling and testing, of certain materials or assemblies when accompanied by manufacturer's certificates of compliance stating that such materials or assemblies fully comply with the requirements of the contract. The certificate shall be signed by the manufacturer. Each lot of such materials or assemblies delivered to the work must be accompanied by a certificate of compliance in which the lot is clearly identified.

Materials or assemblies used on the basis of certificates of compliance may be sampled and tested at any time and if found not to be in conformity with contract requirements will be subject to rejection whether in place or not.

The form and distribution of certificates of compliance shall be as approved by the Engineer.

When a material or assembly is specified by "brand name or equal" and the Contractor elects to furnish the specified "brand name," the Contractor shall be required to furnish the manufacturer's certificate of compliance for each lot of such material or assembly delivered to the work. Such certificate of compliance shall clearly identify each lot delivered and shall certify as to:

- a. Conformance to the specified performance, testing, quality or dimensional requirements; and,
- b. Suitability of the material or assembly for the use intended in the contract work.

Should the Contractor propose to furnish an "or equal" material or assembly, he shall furnish the manufacturer's certificates of compliance as hereinbefore described for the specified brand name material or assembly. However, the Engineer shall be the sole judge as to whether the proposed "or equal" is suitable for use in the work.

The Engineer reserves the right to refuse permission for use of materials or assemblies on the basis of certificates of compliance.

60-04 PLANT INSPECTION. The Engineer or his/her authorized representative may inspect, at its source, any specified material or assembly to be used in the work. Manufacturing plants may be inspected from time to time for the purpose of determining compliance with specified manufacturing methods or

materials to be used in the work and to obtain samples required for his/her acceptance of the material or assembly.

Should the Engineer conduct plant inspections, the following conditions shall exist:

- a. The Engineer shall have the cooperation and assistance of the Contractor and the producer with whom he has contracted for materials.
- b. The Engineer shall have full entry at all reasonable times to such parts of the plant that concern the manufacture or production of the materials being furnished.
- c. If required by the Engineer, the Contractor shall arrange for adequate office or working space that may be reasonably needed for conducting plant inspections. Office or working space should be conveniently located with respect to the plant.

It is understood and agreed that the owner shall have the right to retest any material which has been tested and approved at the source of supply after it has been delivered to the site. The Engineer shall have the right to reject only material which, when retested, does not meet the requirements of the contract, plans, or specifications.

60-05 ENGINEER'S FIELD OFFICE AND LABORATORY. The Contractor shall furnish for the duration of the project one building for the use of the field engineers and inspectors, as a field office. This facility shall be an approved weatherproof building meeting the current State Highway Specifications (for example, Class I Field Office or Type C Structure). This building shall be located conveniently near to the construction and shall be separate from any building used by the Contractor. A land line telephone and answering machine shall be provided. The Contractor shall be responsible for payment of the basic monthly charge and local calls only. Any Long Distance Tolls shall be the responsibility of the caller. The Contractor shall furnish. No direct payment will be made for this building or labor, materials, ground rental, or other expense in connection therewith. The cost hereof shall be included in the price bid for the various items of the contract. The Contractor and his/her superintendent shall provide all reasonable facilities to enable to the Engineer to inspect the workmanship and materials entering into the work.

60-06 STORAGE OF MATERIALS. Materials shall be so stored as to assure the preservation of their quality and fitness for the work. Stored materials, even though approved before storage, may again be inspected prior to their use in the work. Stored materials shall be located so as to facilitate their prompt inspection. The Contractor shall coordinate the storage of all materials with the Engineer. Materials to be stored on airport property shall not create an obstruction to air navigation nor shall they interfere with the free and unobstructed movement of aircraft. Unless otherwise shown on the plans, the storage of materials and the location of the Contractor's plant and parked equipment or vehicles shall be as directed by the Engineer. Private property shall not be used for storage purposes without written permission of the owner or lessee of such property. The Contractor shall make all arrangements and bear all expenses for the storage of materials on private property. Upon request, the Contractor shall furnish the Engineer a copy of the property owner's permission.

All storage sites on private or airport property shall be restored to their original condition by the Contractor at his/her entire expense, except as otherwise agreed to (in writing) by the owner or lessee of the property.

60-07 UNACCEPTABLE MATERIALS. Any material or assembly that does not conform to the requirements of the contract, plans, or specifications shall be considered unacceptable and shall be rejected. The Contractor shall remove any rejected material or assembly from the site of the work, unless otherwise instructed by the Engineer.

Rejected material or assembly, the defects of which have been corrected by the Contractor, shall not be returned to the site of the work until such time as the Engineer has approved its used in the work.

60-08 OWNER FURNISHED MATERIALS. The Contractor shall furnish all materials required to complete the work, except those specified herein (if any) to be furnished by the owner. Owner-furnished materials shall be made available to the Contractor at the location specified herein.

All costs of handling, transportation from the specified location to the site of work, storage, and installing owner-furnished materials shall be included in the unit price bid for the contract item in which such owner-furnished material is used.

After any owner-furnished material has been delivered to the location specified, the Contractor shall be responsible for any demurrage, damage, loss, or other deficiencies which may occur during the Contractor's handling, storage, or use of such owner-furnished material. The owner will deduct from any monies due or to become due the Contractor any cost incurred by the owner in making good such loss due to the Contractor's handling, storage, or use of owner-furnished materials.

END OF SECTION 60

GENERAL PROVISIONS - SECTION 70

LEGAL REGULATIONS AND RESPONSIBILITY TO PUBLIC

70-01 LAWS TO BE OBSERVED. The Contractor shall keep fully informed of all Federal and state laws, all local laws, ordinances, and regulations and all orders and decrees of bodies or tribunals having any jurisdiction or authority, which in any manner affect those engaged or employed on the work, or which in any way affect the conduct of the work. He shall at all times observe and comply with all such laws, ordinances, regulations, orders, and decrees; and shall protect and indemnify the owner and all his/her officers, agents, or servants against any claim or liability arising from or based on the violation of any such law, ordinance, regulation, order, or decree, whether by himself or his/her employees.

70-02 PERMITS, LICENSES, AND TAXES. The Contractor shall procure all permits and licenses, pay all charges, fees, and taxes, and give all notices necessary and incidental to the due and lawful prosecution of the work.

70-03 PATENTED DEVICES, MATERIALS, AND PROCESSES. If the Contractor is required or desires to use any design, device, material, or process covered by letters of patent or copyright, he shall provide for such use by suitable legal agreement with the patentee or owner. The Contractor and the surety shall indemnify and save harmless the owner, any third party, or political subdivision from any and all claims for infringement by reason of the use of any such patented design, device, material or process, or any trademark or copyright, and shall indemnify the owner for any costs, expenses, and damages which it may be obliged to pay by reason of an infringement, at any time during the prosecution or after the completion of the work.

70-04 RESTORATION OF SURFACES DISTURBED BY OTHERS. The owner reserves the right to authorize the construction, reconstruction, or maintenance of any public or private utility service, FAA or National Oceanic and Atmospheric Administration (NOAA) facility, or a utility service of another government agency at any time during the progress of the work. To the extent that such construction, reconstruction, or maintenance has been coordinated with the owner, such authorized work (by others) is indicated as follows:

NONE

Except as listed above, the Contractor shall not permit any individual, firm, or corporation to excavate or otherwise disturb such utility services or facilities located within the limits of the work without the written permission of the Engineer.

Should the owner of public or private utility service, FAA, or NOAA facility, or a utility service of another government agency be authorized to construct, reconstruct, or maintain such utility service or facility during the progress of the work, the Contractor shall cooperate with such owners by arranging and performing the work in this contract so as to facilitate such construction, reconstruction or maintenance by others whether or not such work by others is listed above. When ordered as extra work by the Engineer, the Contractor shall make all necessary repairs to the work which are due to such authorized work by others, unless otherwise provided for in the contract, plans, or specifications. It is understood and agreed that the Contractor shall not be entitled to make any claim for damages due to such authorized work by others or for any delay to the work resulting from such authorized work.

70-05 FEDERAL AID PARTICIPATION. For AIP contracts, the United States Government has agreed to reimburse the owner for some portion of the contract costs. Such reimbursement is made from time to time upon the owner's (sponsor's) request to the FAA. In consideration of the United States Government's (FAA's) agreement with the owner, the owner has included provisions in this contract pursuant to the requirements of the Airport Improvement Act of 1982, as amended by the Airport and Airway Safety and Capacity Expansion Act of 1987, and the Rules and Regulations of the FAA that pertain to the work.

As required by the Act, the contract work is subject to the inspection and approval of duly authorized representatives of the Administrator, FAA, and is further subject to those provisions of the rules and regulations that are cited in the contract, plans, or specifications.

No requirement of the Act, the rules and regulations implementing the Act, or this contract shall be construed as making the Federal Government a party to the contract nor will any such requirement interfere, in any way, with the rights of either party to the contract.

70-06 SANITARY, HEALTH, AND SAFETY PROVISIONS. The Contractor shall provide and maintain in a neat, sanitary condition such accommodations for the use of his/her employees as may be necessary to comply with the requirements of the state and local Board of Health, or of other bodies or tribunals having jurisdiction.

Attention is directed to Federal, state, and local laws, rules and regulations concerning construction safety and health standards. The Contractor shall not require any worker to work in surroundings or under conditions are unsanitary, hazardous, or dangerous to his/her health or safety.

70-07 PUBLIC CONVENIENCE AND SAFETY. The Contractor shall control his/her operations and those of his/her subcontractors and all suppliers, to assure the least inconvenience to the traveling public. Under all circumstances, safety shall be the most important consideration.

The Contractor shall maintain the free and unobstructed movement of aircraft and vehicular traffic with respect to his/her own operations and those of his/her subcontractors and all suppliers in accordance with the subsection titled MAINTENANCE OF TRAFFIC of Section 40 hereinbefore specified and shall limit such operations for the convenience and safety of the traveling public as specified in the subsection titled LIMITATION OF OPERATIONS of Section 80 hereinafter.

70-08 BARRICADES, WARNING SIGNS, AND HAZARD MARKINGS. The Contractor shall furnish, erect, and maintain all barricades, warning signs, and markings for hazards necessary to protect the public and the work. When used during periods of darkness, such barricades, warning signs, and hazard markings shall be suitably illuminated.

For vehicular and pedestrian traffic, the Contractor shall furnish, erect, and maintain barricades, warning signs, lights and other traffic control devices in reasonable conformity with the Manual of Uniform Traffic Control Devices for Streets and Highways (published by the United States Government Printing Office).

When the work requires closing an air operations area of the airport or portion of such area, the Contractor shall furnish, erect, and maintain temporary markings and associated lighting conforming to the requirements of AC 150/5340-1, Marking of Paved Areas on Airports, latest edition.

The Contractor shall furnish, erect, and maintain markings and associated lighting of open trenches, excavations, temporary stockpiles, and his/her parked construction equipment that may be hazardous to

the operation of emergency fire-rescue or maintenance vehicles on the airport in reasonable conformance to AC 150/5370-2, Operational Safety on Airports During Construction Activity, latest edition.

The Contractor shall identify each motorized vehicle or piece of construction equipment in reasonable conformance to AC 150/5370-2, latest edition.

The Contractor shall furnish and erect all barricades, warning signs, and markings for hazards prior to commencing work which requires such erection and shall maintain the barricades, warning signs, and markings for hazards until their dismantling is directed by the Engineer.

Open-flame type lights shall not be permitted within the air operations areas of the airport.

70-09 USE OF EXPLOSIVES. When the use of explosives is necessary for the prosecution of the work, the Contractor shall exercise the utmost care not to endanger life or property, including new work. The Contractor shall be responsible for all damage resulting from the use of explosives.

All explosives shall be stored in a secure manner in compliance with all laws and ordinances, and all such storage places shall be clearly marked. Where no local laws or ordinances apply, storage shall be provided satisfactory to the Engineer and, in general, not closer than 1,000 feet (300 m) from the work or from any building, road, or other place of human occupancy.

The Contractor shall notify each property owner and public utility company having structures or facilities in proximity to the site of the work of his/her intention to use explosives. Such notice shall be given sufficiently in advance to enable them to take such steps as they may deem necessary to protect their property from injury.

The use of electrical blasting caps shall not be permitted on or within 1,000 feet (300 m) of the airport property.

70-10 PROTECTION AND RESTORATION OF PROPERTY AND LANDSCAPE. The Contractor shall be responsible for the preservation of all public and private property, and shall protect carefully from disturbance or damage all land monuments and property markers until the Engineer has witnessed or otherwise referenced their location and shall not move them until directed.

The Contractor shall be responsible for all damage or injury to property of any character, during the prosecution of the work, resulting from any act, omission, neglect, or misconduct in his/her manner or method of executing the work, or at any time due to defective work or materials, and said responsibility will not be released until the project shall have been completed and accepted.

When or where any direct or indirect damage or injury is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work, or in consequence of the nonexecution thereof by the Contractor, he shall restore, at his/her own expense, such property to a condition similar or equal to that existing before such damage or injury was done, by repairing, or otherwise restoring as may be directed, or he shall make good such damage or injury in an acceptable manner.

70-11 RESPONSIBILITY FOR DAMAGE CLAIMS. The Contractor shall indemnify and save harmless the Engineer and the owner and their officers, and employees from all suits actions, or claims of any character

brought because of any injuries or damage received or sustained by any person, persons, or property on account of the operations of the Contractor; or on account of or in consequence of any neglect in safeguarding the work; or through use of unacceptable materials in constructing the work; or because of any act or omission, neglect, or misconduct of said Contractor; or because of any claims or amounts recovered from any infringements of patent, trademark, or copyright; or from any claims or amounts arising or recovered under the "Workmen's Compensation Act," or any other law, ordinance, order, or decree. Money due the Contractor under and by virtue of his/her contract as may be considered necessary by the owner for such purpose may be retained for the use of the owner or, in case no money is due, his/her surety may be held until such suit or suits, action or actions, claim or claims for injuries or damages as aforesaid shall have been settled and suitable evidence to that effect furnished to the owner, except that money due the Contractor will not be withheld when the Contractor produces satisfactory evidence that he is adequately protected by public liability and property damage insurance.

70-12 THIRD PARTY BENEFICIARY CLAUSE. It is specifically agreed between the parties executing the contract that it is not intended by any of the provisions of any part of the contract to create the public or any member thereof a third party beneficiary or to authorize anyone not a party to the contract to maintain a suit for personal injuries or property damage pursuant to the terms or provisions of the contract.

70-13 OPENING SECTIONS OF THE WORK TO TRAFFIC. Should it be necessary for the Contractor to complete portions of the contract work for the beneficial occupancy of the owner prior to completion of the entire contract, such "phasing" of the work shall be specified herein and indicated on the plans. When so specified, the Contractor shall complete such portions of the work on or before the date specified or as otherwise specified. The Contractor shall make his/her own estimate of the difficulties involved in arranging his/her work to permit such beneficial occupancy by the Owner as described below:

Work shall be completed in accordance with the contract time specified.

Upon completion of any portion of the work specified above, such portion shall be accepted by the owner in accordance with the subsection titled PARTIAL ACCEPTANCE of Section 50.

No portion of the work may be opened by the Contractor for public use until ordered by the Engineer in writing. Should it become necessary to open a portion of the work to public traffic on a temporary or intermittent basis, such openings shall be made when, in the opinion of the Engineer, such portion of the work is in an acceptable condition to support the intended traffic. Temporary or intermittent openings are considered to be inherent in the work and shall not constitute either acceptance of the portion of the work so opened or a waiver of any provision of the contract. Any damage to the portion of the work so opened that is not attributable to traffic which is permitted by the owner shall be repaired by the Contractor at his/her expense.

The Contractor shall make his/her own estimate of the inherent difficulties involved in completing the work under the conditions herein described and shall not claim any added compensation by reason of delay or increased cost due to opening a portion of the contract work.

Contractor shall be required to conform to safety standards contained AC 150/5370-2, Operational Safety on Airports During Construction (See Special Provisions.)

Contractor shall refer to the approved safety plan to identify barricade requirements and other safety requirements prior to opening up sections of work to traffic.

70-14 CONTRACTOR'S RESPONSIBILITY FOR WORK. Until the Engineer's final written acceptance of the entire completed work, excepting only those portions of the work accepted in accordance with the subsection titled PARTIAL ACCEPTANCE of Section 50, the Contractor shall have the charge and care thereof and shall take every precaution against injury or damage to any part due to the action of the elements or from any other cause, whether arising from the execution or from the nonexecution of the work. The Contractor shall rebuild, repair, restore, and make good all injuries or damages to any portion of the work occasioned by any of the above causes before final acceptance and shall bear the expense thereof except damage to the work due to unforeseeable causes beyond the control of and without the fault or negligence of the Contractor, including but not restricted to acts of God such as earthquake, tidal wave, tornado, hurricane or other cataclysmic phenomenon of nature, or acts of the public enemy or of government authorities.

If the work is suspended for any cause whatever, the Contractor shall be responsible for the work and shall take such precautions necessary to prevent damage to the work. The Contractor shall provide for normal drainage and shall erect necessary temporary structures, signs, or other facilities at his/her expense. During such period of suspension of work, the Contractor shall properly and continuously maintain in an acceptable growing condition all living material in newly established planting, seedings, and soddings furnished under his/her contract, and shall take adequate precautions to protect new tree growth and other important vegetative growth against injury.

70-15 CONTRACTOR'S RESPONSIBILITY FOR UTILITY SERVICE AND FACILITIES OF OTHERS. As provided in the subsection titled RESTORATION OF SURFACES DISTURBED BY OTHERS of this section, the Contractor shall cooperate with the owner of any public or private utility service, FAA or NOAA, or a utility service of another government agency that may be authorized by the owner to construct, reconstruct or maintain such utility services or facilities during the progress of the work. In addition, the Contractor shall control his/her operations to prevent the unscheduled interruption of such utility services and facilities.

To the extent that such public or private utility services, FAA, or NOAA facilities, or utility services of another governmental agency are known to exist within the limits of the contract work, the approximate locations have been indicated on the plans and the owners are indicated as follows:

Sunshine State One (Utility Location Service) Contractor shall call no less than 48 hours prior to digging
800-432-4770

FAA Facilities: FAA contact information to be provided by Engineer

Owner's Emergency Contact: Douglas Glass 850-573-6360

Engineer (AVCON, INC.) John Collins, P.E. 850-678-0050

It is understood and agreed that the owner does not guarantee the accuracy or the completeness of the location information relating to existing utility services, facilities, or structures that may be shown on the plans or encountered in the work. Any inaccuracy or omission in such information shall not relieve the Contractor of his/her responsibility to protect such existing features from damage or unscheduled interruption of service.

It is further understood and agreed that the Contractor shall, upon execution of the contract, notify the owners of all utility services or other facilities of his/her plan of operations. Such notification shall be in writing addressed to THE PERSON TO CONTACT as provided hereinbefore in this subsection and the

subsection titled RESTORATION OF SURFACES DISTURBED BY OTHERS of this section. A copy of each notification shall be given to the Engineer.

In addition to the general written notification hereinbefore provided, it shall be the responsibility of the Contractor to keep such individual owners advised of changes in his/her plan of operations that would affect such owners.

Prior to commencing the work in the general vicinity of an existing utility service or facility, the Contractor shall again notify each such owner of his/her plan of operation. If, in the Contractor's opinion, the owner's assistance is needed to locate the utility service or facility or the presence of a representative of the owner is desirable to observe the work, such advice should be included in the notification. Such notification shall be given by the most expeditious means to reach the utility owner's PERSON TO CONTACT no later than two normal business days prior to the Contractor's commencement of operations in such general vicinity. The Contractor shall furnish a written summary of the notification to the Engineer.

The Contractor's failure to give the two day's notice hereinabove provided shall be cause for the Engineer to suspend the Contractor's operations in the general vicinity of a utility service or facility.

Where the outside limits of an underground utility service have been located and staked on the ground, the Contractor shall be required to use excavation methods acceptable to the Engineer within 3 feet (90 cm) of such outside limits at such points as may be required to ensure protection from damage due to the Contractor's operations.

Should the Contractor damage or interrupt the operation of a utility service or facility by accident or otherwise, he shall immediately notify the proper authority and the Engineer and shall take all reasonable measures to prevent further damage or interruption of service. The Contractor, in such events, shall cooperate with the utility service or facility owner and the Engineer continuously until such damage has been repaired and service restored to the satisfaction of the utility or facility owner.

The Contractor shall bear all costs of damage and restoration of service to any utility service or facility due to his/her operations whether or not due to negligence or accident. The contract owner reserves the right to deduct such costs from any monies due or which may become due the Contractor, or his/her surety.

70-15.1 FAA FACILITIES AND CABLE RUNS. The Contractor is hereby advised that the construction limits of the project include existing facilities and buried cable runs that are owned, operated and maintained by the FAA. The Contractor, during the prosecution of the project work, shall comply with the following:

- a. The Contractor shall permit FAA maintenance personnel the right of access to the project work site for purposes of inspecting and maintaining all existing FAA owned facilities.
- b. The Contractor shall notify the above named FAA Airway Facilities Point-of-Contact seven (7) calendar days prior to commencement of construction activities in order to permit sufficient time to locate and mark existing buried cables and to schedule any required facility outages.
- c. If prosecution of the project work requires a facility outage, the Contractor shall contact the above named FAA Point-of-Contact a minimum of 48 hours prior to the time of the required outage.

- d. If prosecution of the project work results in damages to existing FAA equipment or cables, the Contractor shall repair the damaged item in conformance with FAA Airway Facilities' standards to the satisfaction of the above named FAA Point-of-Contact.
- e. If the project work requires the cutting or splicing of FAA owned cables, the above named FAA Point-of-Contact shall be contacted a minimum of 48 hours prior to the time the cable work commences. The FAA reserves the right to have a FAA Airway Facilities representative on site to observe the splicing of the cables as a condition of acceptance. All cable splices are to be accomplished in accordance with FAA Airway Facilities' specifications and require approval by the above named FAA Point-of-Contact as a condition of acceptance by the Owner. The Contractor is hereby advised that FAA Airway Facilities restricts the location of where splices may be installed. If a cable splice is required in a location that is not permitted by FAA Airway Facilities, the Contractor shall furnish and install a sufficient length of new cable that eliminates the need for any splice.

70-16 FURNISHING RIGHTS-OF-WAY. The owner will be responsible for furnishing all rights-of-way upon which the work is to be constructed in advance of the Contractor's operations.

70-17 PERSONAL LIABILITY OF PUBLIC OFFICIALS. In carrying out any of the contract provisions or in exercising any power or authority granted to him by this contract, there shall be no liability upon the Engineer, his/her authorized representatives, or any officials of the owner either personally or as an official of the owner. It is understood that in such matters they act solely as agents and representatives of the owner.

70-18 NO WAIVER OF LEGAL RIGHTS. Upon completion of the work, the owner will expeditiously make final inspection and notify the Contractor of final acceptance. Such final acceptance, however, shall not preclude or estop the owner from correcting any measurement, estimate, or certificate made before or after completion of the work, nor shall the owner be precluded or estopped from recovering from the Contractor or his/her surety, or both, such overpayment as may be sustained, or by failure on the part of the Contractor to fulfill his/her obligations under the contract. A waiver on the part of the owner of any breach of any part of the contract shall not be held to be a waiver of any other or subsequent breach.

The Contractor, without prejudice to the terms of the contract, shall be liable to the owner for latent defects, fraud, or such gross mistakes as may amount to fraud, or as regards the owner's rights under any warranty or guaranty.

70-19 ENVIRONMENTAL PROTECTION. The Contractor shall comply with all Federal, state, and local laws and regulations controlling pollution of the environment. He shall take necessary precautions to prevent pollution of streams, lakes, ponds, and reservoirs with fuels, oils, bitumens, chemicals, or other harmful materials and to prevent pollution of the atmosphere from particulate and gaseous matter.

70-20 ARCHAEOLOGICAL AND HISTORICAL FINDINGS. Unless otherwise specified in this subsection, the Contractor is advised that the site of the work is not within any property, district, or site, and does not contain any building, structure, or object listed in the current National Register of Historic Places published by the United States Department of Interior.

Should the Contractor encounter, during his/her operations, any building, part of a building, structure, or object which is incongruous with its surroundings, he shall immediately cease operations in that location

and notify the Engineer. The Engineer will immediately investigate the Contractor's finding and will direct the Contractor to either resume his/her operations or to suspend operations as directed.

Should the Engineer order suspension of the Contractor's operations in order to protect an archaeological or historical finding, or order the Contractor to perform extra work, such shall be covered by an appropriate contract modification (change order or supplemental agreement) as provided in the subsection titled EXTRA WORK of Section 40 and the subsection titled PAYMENT FOR EXTRA WORK AND FORCE ACCOUNT WORK of Section 90. If appropriate, the contract modification shall include an extension of contract time in accordance with the subsection titled DETERMINATION AND EXTENSION OF CONTRACT TIME of Section 80.

END OF SECTION 70

GENERAL PROVISIONS - SECTION 80

PROSECUTION AND PROGRESS

80-01 SUBLETTING OF CONTRACT. The owner will not recognize any subcontractor on the work. The Contractor shall at all times when work is in progress be represented either in person, by a qualified superintendent, or by other designated, qualified representative who is duly authorized to receive and execute orders of the Engineer.

Should the Contractor elect to assign his/her contract, said assignment shall be concurred in by the surety, shall be presented for the consideration and approval of the owner, and shall be consummated only on the written approval of the owner. In case of approval, the Contractor shall file copies of all subcontracts with the Engineer.

The Contractor shall perform, with his organization, an amount of work equal to at least 25% percent of the total contract cost.

80-02 NOTICE TO PROCEED. The notice to proceed shall state the date on which it is expected the Contractor will begin the construction and from which date contract time will be charged. The Contractor shall begin the work to be performed under the contract within 10 days of the date set by the Engineer in the written notice to proceed, but in any event, the Contractor shall notify the Engineer at least 24 hours in advance of the time actual construction operations will begin.

80-03 PROSECUTION AND PROGRESS. Unless otherwise specified, the Contractor shall submit his/her progress schedule for the Engineer's approval within 10 days after the effective date of the notice to proceed. The Contractor's progress schedule, when approved by the Engineer, may be used to establish major construction operations and to check on the progress of the work. The Contractor shall provide sufficient materials, equipment, and labor to guarantee the completion of the project in accordance with the plans and specifications within the time set forth in the proposal.

If the Contractor falls significantly behind the submitted schedule, the Contractor shall, upon the Engineer's request, submit a revised schedule for completion of the work within the contract time and modify his/her operations to provide such additional materials, equipment, and labor necessary to meet the revised schedule. Should the prosecution of the work be discontinued for any reason, the Contractor shall notify the Engineer at least 24 hours in advance of resuming operations.

The Contractor shall not commence any actual construction prior to the date on which the notice to proceed is issued by the owner.

80-04 LIMITATION OF OPERATIONS. The Contractor shall control his/her operations and the operations of his/her subcontractors and all suppliers so as to provide for the free and unobstructed movement of aircraft in the AIR OPERATIONS AREAS of the airport.

When the work requires the Contractor to conduct his/her operations within an AIR OPERATIONS AREA of the airport, the work shall be coordinated with airport management (through the Engineer) at least 48 hours prior to commencement of such work. The Contractor shall not close an AIR OPERATIONS AREA until so authorized by the Engineer and until the necessary temporary marking and associated lighting is in place as provided in the subsection titled BARRICADES, WARNING SIGNS, AND HAZARD MARKINGS of Section 70.

When the contract work requires the Contractor to work within an AIR OPERATIONS AREA of the airport on an intermittent basis (intermittent opening and closing of the AIR OPERATIONS AREA), the Contractor shall maintain constant communications as hereinafter specified; immediately obey all instructions to vacate the AIR OPERATIONS AREA; immediately obey all instructions to resume work in such AIR OPERATIONS AREA. Failure to maintain the specified communications or to obey instructions shall be cause for suspension of the Contractor's operations in the AIR OPERATIONS AREA until the satisfactory conditions are provided. The following AIR OPERATIONS AREA (AOA) cannot be closed to operating aircraft to permit the Contractor's operations on a continuous basis and will therefore be closed to aircraft operations intermittently as follows:

NONE

Contractor shall be required to conform to safety standards contained in AC 150/5370-2, Operational Safety on Airports During Construction (See Special Provisions).

80-04.1 OPERATIONAL SAFETY ON AIRPORT DURING CONSTRUCTION. All Contractors' operations shall be conducted in accordance with the project safety plan and the provisions set forth within the current version of Advisory Circular 150/5370-2. The safety plan included within the contract documents conveys minimum requirements for operational safety on the airport during construction activities. The Contractor shall prepare and submit a plan that details how it proposes to comply with the requirements presented within the safety plan.

The Contractor shall implement all necessary safety plan measures prior to commencement of any work activity. The Contractor shall conduct routine checks of the safety plan measures to assure compliance with the safety plan measures.

The Contractor is responsible to the Owner for the conduct of all subcontractors it employs on the project. The Contractor shall assure that all subcontractors are made aware of the requirements of the safety plan and that they implement and maintain all necessary measures.

No deviation or modifications may be made to the approved safety plan unless approved in writing by the Owner or Engineer.

80-05 CHARACTER OF WORKERS, METHODS, AND EQUIPMENT. The Contractor shall, at all times, employ sufficient labor and equipment for prosecuting the work to full completion in the manner and time required by the contract, plans, and specifications.

All workers shall have sufficient skill and experience to perform properly the work assigned to them. Workers engaged in special work or skilled work shall have sufficient experience in such work and in the operation of the equipment required to perform the work satisfactorily.

Should the Contractor fail to remove such persons or person, or fail to furnish suitable and sufficient personnel for the proper prosecution of the work, the Engineer may suspend the work by written notice until compliance with such orders.

All equipment which is proposed to be used on the work shall be of sufficient size and in such mechanical condition as to meet requirements of the work and to produce a satisfactory quality of work. Equipment used on any portion of the work shall be such that no injury to previously completed work, adjacent property, or existing airport facilities will result from its use.

When the methods and equipment to be used by the Contractor in accomplishing the work are not prescribed in the contract, the Contractor is free to use any methods or equipment that will accomplish the work in conformity with the requirements of the contract, plans, and specifications.

When the contract specifies the use of certain methods and equipment, such methods and equipment shall be used unless others are authorized by the Engineer. If the Contractor desires to use a method or type of equipment other than specified in the contract, he may request authority from the Engineer to do so. The request shall be in writing and shall include a full description of the methods and equipment proposed and of the reasons for desiring to make the change. If approval is given, it will be on the condition that the Contractor will be fully responsible for producing work in conformity with contract requirements. If, after trial use of the substituted methods or equipment, the Engineer determines that the work produced does not meet contract requirements, the Contractor shall discontinue the use of the substitute method or equipment and shall complete the remaining work with the specified methods and equipment. The Contractor shall remove any deficient work and replace it with work of specified quality, or take such other corrective action as the Engineer may direct. No change will be made in basis of payment for the contract items involved nor in contract time as a result of authorizing a change in methods or equipment under this subsection.

80-06 TEMPORARY SUSPENSION OF THE WORK. The Owner shall have the authority to suspend the work wholly, or in part, for such period or periods as he may deem necessary, due to unsuitable weather, or such other conditions as are considered unfavorable for the prosecution of the work, or for such time as is necessary due to the failure on the part of the Contractor to carry out orders given or perform any or all provisions of the contract.

In the event that the Contractor is ordered by the Owner, in writing, to suspend work for some unforeseen cause not otherwise provided for in the contract and over which the Contractor has no control, the Contractor may be reimbursed for actual money expended on the work during the period of shutdown. No allowance will be made for anticipated profits. The period of shutdown shall be computed from the effective date of the Engineer's order to suspend work to the effective date of the Engineer's order to resume the work. Claims for such compensation shall be filed with the Engineer within the time period stated in the Engineer's order to resume work. The Contractor shall submit with his/her claim information substantiating the amount shown on the claim. The Engineer will forward the Contractor's claim to the Owner for consideration in accordance with local laws or ordinances. No provision of this article shall be construed as entitling the Contractor to compensation for delays due to inclement weather, for suspensions made at the request of the Owner, or for any other delay provided for in the contract, plans, or specifications.

If it should become necessary to suspend work for an indefinite period, the Contractor shall store all materials in such manner that they will not become an obstruction nor become damaged in any way. He shall take every precaution to prevent damage or deterioration of the work performed and provide for normal drainage of the work. The Contractor shall erect temporary structures where necessary to provide for traffic on, to, or from the airport.

80-07 DETERMINATION AND EXTENSION OF CONTRACT TIME. The number of calendar or working days allowed for completion of the work shall be stated in the proposal and contract and shall be known as the CONTRACT TIME.

Should the contract time require extension for reasons beyond the Contractor's control, it shall be adjusted as follows:

- a. CONTRACT TIME based on WORKING DAYS shall be calculated weekly by the Engineer. The Engineer will furnish the Contractor a copy of his/her weekly statement of the number of working days charged against the contract time during the week and the number of working days currently specified for completion of the contract (the original contract time plus the number of working days, if any, that have been included in approved CHANGE ORDERS or SUPPLEMENTAL AGREEMENTS covering EXTRA WORK).

The Engineer shall base his/her weekly statement of contract time charged on the following considerations:

- (1) No time shall be charged for days on which the Contractor is unable to proceed with the principal item of work under construction at the time for at least 6 hours with the normal work force employed on such principal item. Should the normal work force be on a double-shift, 12 hours shall be used. Should the normal work force be on a triple-shift, 18 hours shall apply. Conditions beyond the Contractor's control such as strikes, lockouts, unusual delays in transportation, temporary suspension of the principal item of work under construction or temporary suspension of the entire work which have been ordered by the Owner for reasons not the fault of the Contractor, shall not be charged against the contract time.
- (2) The Engineer will not make charges against the contract time prior to the effective date of the notice to proceed.
- (3) The Engineer will begin charges against the contract time on the first working day after the effective date of the notice to proceed.
- (4) The Engineer will not make charges against the contract time after the date of final acceptance as defined in the subsection titled FINAL ACCEPTANCE of Section 50.
- (5) The Contractor will be allowed 1 week in which to file a written protest setting forth his/her objections to the Engineer's weekly statement. If no objection is filed within such specified time, the weekly statement shall be considered as acceptable to the Contractor.

The contract time (stated in the proposal) is based on the originally estimated quantities as described in the subsection titled INTERPRETATION OF ESTIMATED PROPOSAL QUANTITIES of Section 20. Should the satisfactory completion of the contract require performance of work in greater quantities than those estimated in the proposal, the contract time shall be increased in the same proportion as the cost of the actually completed quantities bears to the cost of the originally estimated quantities in the proposal. Such increase in contract time shall not consider either the cost of work or the extension of contract time that has been covered by change order or supplemental agreement and shall be made at the time of final payment.

- b. CONTRACT TIME based on CALENDAR DAYS shall consist of the number of calendar days stated in the contract counting from the effective date of the notice to proceed and including all Saturdays, Sundays, holidays, and nonwork days. All calendar days elapsing between the effective dates of the Owner's orders to suspend and resume all work, due to causes not the fault of the Contractor, shall be excluded.

At the time of final payment, the contract time shall be increased in the same proportion as the cost of the actually completed quantities bears to the cost of the originally estimated quantities in the proposal. Such increase in the contract time shall not consider either cost of work or the extension of contract time that has been covered by a change order or supplemental agreement. Charges against the contract time will cease as of the date of final acceptance.

- c. When the contract time is a specified completion date, it shall be the date on which all contract work shall be substantially completed.

If the Contractor finds it impossible for reasons beyond his/her control to complete the work within the contract time as specified, or as extended in accordance with the provisions of this subsection, he may, at any time prior to the expiration of the contract time as extended, make a written request to the Engineer for an extension of time setting forth the reasons which he believes will justify the granting of his/her request. Requests for extension of time on calendar day projects, caused by inclement weather, shall be supported with National Weather Bureau data showing the actual amount of inclement weather exceeded which could normally be expected during the contract period. The Contractor's plea that insufficient time was specified is not a valid reason for extension of time. If the Engineer finds that the work was delayed because of conditions beyond the control and without the fault of the Contractor, he may extend the time for completion in such amount as the conditions justify. The extended time for completion shall then be in full force and effect, the same as though it were the original time for completion.

80-08 FAILURE TO COMPLETE ON TIME. For each calendar day or working day, as specified in the contract, that any work remains uncompleted after the contract time (including all extensions and adjustments as provided in the subsection titled DETERMINATION AND EXTENSION OF CONTRACT TIME of this Section) the sum specified in the contract and proposal as liquidated damages will be deducted from any money due or to become due the Contractor or his/her surety. Such deducted sums shall not be deducted as a penalty but shall be considered as liquidation of a reasonable portion of damages that will be incurred by the owner should the Contractor fail to complete the work in the time provided in his/her contract.

Permitting the Contractor to continue and finish the work or any part of it after the time fixed for its completion, or after the date to which the time for completion may have been extended, will in no way operate as a waiver on the part of the owner of any of its rights under the contract.

80-09 DEFAULT AND TERMINATION OF CONTRACT. The Contractor shall be considered in default of his/her contract and such default will be considered as cause for the owner to terminate the contract for any of the following reasons if the Contractor:

- a. Fails to begin the work under the contract within the time specified in the "Notice to Proceed,"
or
- b. Fails to perform the work or fails to provide sufficient workers, equipment or materials to assure completion of work in accordance with the terms of the contract, or
- c. Performs the work unsuitably or neglects or refuses to remove materials or to perform anew such work as may be rejected as unacceptable and unsuitable, or
- d. Discontinues the prosecution of the work, or

- e. Fails to resume work which has been discontinued within a reasonable time after notice to do so, or
- f. Becomes insolvent or is declared bankrupt, or commits any act of bankruptcy or insolvency, or
- g. Allows any final judgment to stand against him unsatisfied for a period of 10 days, or
- h. Makes an assignment for the benefit of creditors, or
- i. For any other cause whatsoever, fails to carry on the work in an acceptable manner.

Should the Engineer consider the Contractor in default of the contract for any reason hereinbefore, he shall immediately give written notice to the Contractor and the Contractor's surety as to the reasons for considering the Contractor in default and the owner's intentions to terminate the contract.

If the Contractor or surety, within a period of 10 days after such notice, does not proceed in accordance therewith, then the owner will, upon written notification from the Engineer of the facts of such delay, neglect, or default and the Contractor's failure to comply with such notice, have full power and authority without violating the contract, to take the prosecution of the work out of the hands of the Contractor. The owner may appropriate or use any or all materials and equipment that have been mobilized for use in the work and are acceptable and may enter into an agreement for the completion of said contract according to the terms and provisions thereof, or use such other methods as in the opinion of the Engineer will be required for the completion of said contract in an acceptable manner.

All costs and charges incurred by the owner, together with the cost of completing the work under contract, will be deducted from any monies due or which may become due the Contractor. If such expense exceeds the sum which would have been payable under the contract, then the Contractor and the surety shall be liable and shall pay to the owner the amount of such excess.

80-10 TERMINATION FOR NATIONAL EMERGENCIES. The owner shall terminate the contract or portion thereof by written notice when the Contractor is prevented from proceeding with the construction contract as a direct result of an Executive Order of the President with respect to the prosecution of war or in the interest of national defense.

When the contract, or any portion thereof, is terminated before completion of all items of work in the contract, payment will be made for the actual number of units or items of work completed at the contract price or as mutually agreed for items of work partially completed or not started. No claims or loss of anticipated profits shall be considered.

Reimbursement for organization of the work, and other overhead expenses, (when not otherwise included in the contract) and moving equipment and materials to and from the job will be considered, the intent being that an equitable settlement will be made with the Contractor.

Acceptable materials, obtained or ordered by the Contractor for the work and that are not incorporated in the work shall, at the option of the Contractor, be purchased from the Contractor at actual cost as shown by receipted bills and actual cost records at such points of delivery as may be designated by the Engineer.

Termination of the contract or a portion thereof shall neither relieve the Contractor of his/her responsibilities for the completed work nor shall it relieve his/her surety of its obligation for and concerning any just claim arising out of the work performed.

80-11 WORK AREA, STORAGE AREA AND SEQUENCE OF OPERATIONS. The Contractor shall obtain approval from the Engineer prior to beginning any work in all areas of the airport. No operating runway, taxiway, or Air Operations Area (AOA) shall be crossed, entered, or obstructed while it is operational. The Contractor shall plan and coordinate his/her work in such a manner as to insure safety and a minimum of hindrance to flight operations. All Contractor equipment and material stockpiles shall be stored a minimum of **[500]** feet from the centerline of an active runway **and 500' from an active taxiway**. No equipment will be allowed to park within the approach area of an active runway at any time. No equipment shall be within 500 feet of an active runway at any time.

END OF SECTION 80

GENERAL PROVISIONS - SECTION 90

MEASUREMENT AND PAYMENT

90-01 MEASUREMENT OF QUANTITIES. All work completed under the contract will be measured by the Engineer, or his/her authorized representatives, using United States Customary Units of Measurement or the International System of Units.

The method of measurement and computations to be used in determination of quantities of material furnished and of work performed under the contract will be those methods generally recognized as conforming to good engineering practice.

Unless otherwise specified, longitudinal measurements for area computations will be made horizontally, and no deductions will be made for individual fixtures (or leave-outs) having an area of 9 square feet (0.8 square meter) or less. Unless otherwise specified, transverse measurements for area computations will be the neat dimensions shown on the plans or ordered in writing by the Engineer.

Structures will be measured according to neat lines shown on the plans or as altered to fit field conditions.

Unless otherwise specified, all contract items which are measured by the linear foot such as electrical ducts, conduits, pipe culverts, underdrains, and similar items shall be measured parallel to the base or foundation upon which such items are placed.

In computing volumes of excavation the average end area method or other acceptable methods will be used.

The thickness of plates and galvanized sheet used in the manufacture of corrugated metal pipe, metal plate pipe culverts and arches, and metal cribbing will be specified and measured in decimal fraction of inches.

The term "ton" will mean the short ton consisting of 2,000 pounds (907 kilograms) avoirdupois. All materials which are measured or proportioned by weights shall be weighed on accurate, approved scales by competent, qualified personnel at locations designed by the Engineer. If material is shipped by rail, the car weight may be accepted provided that only the actual weight of material be paid for. However, car weights will not be acceptable for material to be passed through mixing plants. Trucks used to haul material being paid for by weight shall be weighed empty daily at such times as the Engineer directs, and each truck shall bear a plainly legible identification mark.

Materials to be measured by volume in the hauling vehicle shall be hauled in approved vehicles and measured therein at the point of delivery. Vehicles for this purpose may be of any size or type acceptable to the Engineer, provided that the body is of such shape that the actual contents may be readily and accurately determined. All vehicles shall be loaded to at least their water level capacity, and all loads shall be leveled when the vehicles arrive at the point of delivery.

When requested by the Contractor and approved by the Engineer in writing, material specified to be measured by the cubic yard (cubic meter) may be weighed, and such weights will be converted to cubic yards (cubic meters) for payment purposes. Factors for conversion from weight measurement to volume measurement will be determined by the Engineer and shall be agreed to by the Contractor before such method of measurement of pay quantities is used.

Bituminous materials will be measured by the gallon (liter) or ton (kilogram). When measured by volume, such volumes will be measured at 60 °F (15 °C) or will be corrected to the volume at 60 °F (15 °C) using ASTM D 1250 for asphalts or ASTM D 633 for tars.

Net certified scale weights or weights based on certified volumes in the case of rail shipments will be used as a basis of measurement, subject to correction when bituminous material has been lost from the car or the distributor, wasted, or otherwise not incorporated in the work.

When bituminous materials are shipped by truck or transport, net certified weights by volume, subject to correction for loss or foaming, may be used for computing quantities.

Cement will be measured by the ton (kilogram) or hundredweight (kilogram).

Timber will be measured by the thousand feet board measure (M.F.B.M.) actually incorporated in the structure. Measurement will be based on nominal widths and thicknesses and the extreme length of each piece.

The term "lump sum" when used as an item of payment will mean complete payment for the work described in the contract.

When a complete structure or structural unit (in effect, "lump sum" work) is specified as the unit of measurement, the unit will be construed to include all necessary fittings and accessories.

Rental of equipment will be measured by time in hours of actual working time and necessary traveling time of the equipment within the limits of the work. Special equipment ordered by the Engineer in connection with force account work will be measured as agreed in the change order or supplemental agreement authorizing such force account work as provided in the subsection titled PAYMENT FOR EXTRA AND FORCE ACCOUNT WORK of this section.

When standard manufactured items are specified such as fence, wire, plates, rolled shapes, pipe conduit, etc., and these items are identified by gage, unit weight, section dimensions, etc., such identification will be considered to be nominal weights or dimensions. Unless more stringently controlled by tolerances in cited specifications, manufacturing tolerances established by the industries involved will be accepted.

Scales for weighing materials which are required to be proportioned or measured and paid for by weight shall be furnished, erected, and maintained by the Contractor, or be certified permanently installed commercial scales.

Scales shall be accurate within one-half percent of the correct weight throughout the range of use. The Contractor shall have the scales checked under the observation of the inspector before beginning work and at such other times as requested. The intervals shall be uniform in spacing throughout the graduated or marked length of the beam or dial and shall not exceed one-tenth of 1 percent of the nominal rated capacity of the scale, but not less than 1 pound (454 grams). The use of spring balances will not be permitted.

Beams, dials, platforms, and other scale equipment shall be so arranged that the operator and the inspector can safely and conveniently view them.

Scale installations shall have available ten standard 50-pound (2.3 kilogram) weights for testing the weighing equipment or suitable weights and devices for other approved equipment.

Scales must be tested for accuracy and serviced before use at a new site. Platform scales shall be installed and maintained with the platform level and rigid bulkheads at each end.

Scales "overweighing" (indicating more than correct weight) will not be permitted to operate, and all materials received subsequent to the last previous correct weighting-accuracy test will be reduced by the percentage of error in excess of one-half of 1 percent.

In the event inspection reveals the scales have been "underweighing" (indicating less than correct weight), they shall be adjusted, and no additional payment to the Contractor will be allowed for materials previously weighed and recorded.

All costs in connection with furnishing, installing, certifying, testing, and maintaining scales; for furnishing check weights and scale house; and for all other items specified in this subsection, for the weighing of materials for proportioning or payment, shall be included in the unit contract prices for the various items of the project.

When the estimated quantities for a specific portion of the work are designated as the pay quantities in the contract, they shall be the final quantities for which payment for such specific portion of the work will be made, unless the dimensions of said portions of the work shown on the plans are revised by the Engineer. If revised dimensions result in an increase or decrease in the quantities of such work, the final quantities for payment will be revised in the amount represented by the authorized changes in the dimensions.

90-02 SCOPE OF PAYMENT. The Contractor shall receive and accept compensation provided for in the contract as full payment for furnishing all materials, for performing all work under the contract in a complete and acceptable manner, and for all risk, loss, damage, or expense of whatever character arising out of the nature of the work or the prosecution thereof, subject to the provisions of the subsection titled NO WAIVER OF LEGAL RIGHTS of Section 70.

When the "basis of payment" subsection of a technical specification requires that the contract price (price bid) include compensation for certain work or material essential to the item, this same work or material will not also be measured for payment under any other contract item which may appear elsewhere in the contract, plans, or specifications.

90-03 COMPENSATION FOR ALTERED QUANTITIES. When the accepted quantities of work vary from the quantities in the proposal, the Contractor shall accept as payment in full, so far as contract items are concerned, payment at the original contract price for the accepted quantities of work actually completed and accepted. No allowance, except as provided for in the subsection titled ALTERATION OF WORK AND QUANTITIES of Section 40 will be made for any increased expense, loss of expected reimbursement, or loss of anticipated profits suffered or claimed by the Contractor which results directly from such alterations or indirectly from his/her unbalanced allocation of overhead and profit among the contract items, or from any other cause.

90-04 PAYMENT FOR OMITTED ITEMS. As specified in the subsection titled OMITTED ITEMS of Section 40, the Engineer shall have the right to omit from the work (order nonperformance) any contract item, except major contract items, in the best interest of the owner.

Should the Engineer omit or order nonperformance of a contract item or portion of such item from the work, the Contractor shall accept payment in full at the contract prices for any work actually completed and acceptable prior to the Engineer's order to omit or nonperform such contract item.

Acceptable materials ordered by the Contractor or delivered on the work prior to the date of the Engineer's order will be paid for at the actual cost to the Contractor and shall thereupon become the property of the owner.

In addition to the reimbursement hereinbefore provided, the Contractor shall be reimbursed for all actual costs incurred for the purpose of performing the omitted contract item prior to the date of the Engineer's order. Such additional costs incurred by the Contractor must be directly related to the deleted contract item and shall be supported by certified statements by the Contractor as to the nature the amount of such costs.

90-05 PAYMENT FOR EXTRA AND FORCE ACCOUNT WORK. Extra work, performed in accordance with the subsection titled EXTRA WORK of Section 40, will be paid for at the contract prices or agreed prices specified in the change order or supplemental agreement authorizing the extra work. When the change order or supplemental agreement authorizing the extra work requires that it be done by force account, such force account shall be measured and paid for based on expended labor, equipment, and materials plus a negotiated and agreed upon allowance for overhead and profit.

- a. **Miscellaneous.** No additional allowance will be made for general superintendence, the use of small tools, or other costs for which no specific allowance is herein provided.
- b. **Comparison of Record.** The Contractor and the Engineer shall compare records of the cost of force account work at the end of each day. Agreement shall be indicated by signature of the Contractor and the Engineer or their duly authorized representatives.
- c. **Statement.** No payment will be made for work performed on a force account basis until the Contractor has furnished the Engineer with duplicate itemized statements of the cost of such force account work detailed as follows:
 - (1) Name, classification, date, daily hours, total hours, rate and extension for each laborer and foreman.
 - (2) Designation, dates, daily hours, total hours, rental rate, and extension for each unit of machinery and equipment.
 - (3) Quantities of materials, prices, and extensions.
 - (4) Transportation of materials.
 - (5) Cost of property damage, liability and workman's compensation insurance premiums, unemployment insurance contributions, and social security tax.

Statements shall be accompanied and supported by a receipted invoice for all materials used and transportation charges. However, if materials used on the force account work are not specifically purchased for such work but are taken from the Contractor's stock, then in lieu of the invoices the Contractor shall furnish an affidavit certifying that such materials were taken from his/her

stock, that the quantity claimed was actually used, and that the price and transportation claimed represent the actual cost to the Contractor.

90-06 PARTIAL PAYMENTS. Partial payments will be made at least once each month as the work progresses. Said payments will be based upon estimates prepared by the Engineer of the value of the work performed and materials complete in place in accordance with the contract, plans, and specifications. Such partial payments may also include the delivered actual cost of those materials stockpiled and stored in accordance with the subsection titled PAYMENT FOR MATERIALS ON HAND of this section.

No partial payment will be made when the amount due the Contractor since the last estimate amounts to less than five hundred dollars (\$500.00).

From the total of the amount determined to be payable on a partial payment, 10 percent of such total amount will be deducted and retained by the owner until the final payment is made, except as may be provided (at the Contractor's option) in the subsection titled PAYMENT OF WITHHELD FUNDS of this section. The balance (90 percent) of the amount payable, less all previous payments, shall be certified for payment. Should the Contractor exercise his/her option, as provided in the subsection titled PAYMENT OF WITHHELD FUNDS of this section, no such 10 percent retainage shall be deducted.

When not less than 95 percent of the work has been completed the Engineer may, at his/her discretion and with the consent of the surety, prepare an estimate from which will be retained an amount not less than twice the contract value or estimated cost, whichever is greater, of the work remaining to be done. The remainder, less all previous payments and deductions, will then be certified for payment to the Contractor.

It is understood and agreed that the Contractor shall not be entitled to demand or receive partial payment based on quantities of work in excess of those provided in the proposal or covered by approved change orders or supplemental agreements, except when such excess quantities have been determined by the Engineer to be a part of the final quantity for the item of work in question.

No partial payment shall bind the owner to the acceptance of any materials or work in place as to quality or quantity. All partial payments are subject to correction at the time of final payment as provided in the subsection titled ACCEPTANCE AND FINAL PAYMENT of this section.

The Contractor shall deliver to the Owner a complete release of all claims for labor and material arising out of this contract before the final retained percentage or final payment is made. If any subcontractor or supplier fails to furnish such a release in full, the Contractor may furnish a bond or other collateral satisfactory to the Owner to indemnify the Owner against any potential lien or other such claim. The bond or collateral shall include all costs, expenses, and attorney fees the Owner may be compelled to pay in discharging any such lien or claim.

90-07 PAYMENT FOR MATERIALS ON HAND. Partial payments may be made to the extent of the delivered cost of materials to be incorporated in the work, provided that such materials meet the requirements of the contract, plans, and specifications and are delivered to acceptable sites on the airport property or at other sites in the vicinity that are acceptable to the owner. Such delivered costs of stored or stockpiled materials may be included in the next partial payment after the following conditions are met:

- a. The material has been stored or stockpiled in a manner acceptable to the Engineer at or on an approved site.
- b. The Contractor has furnished the Engineer with acceptable evidence of the quantity and quality of such stored or stockpiled materials.
- c. The Contractor has furnished the Engineer with satisfactory evidence that the material and transportation costs have been paid.
- d. The Contractor has furnished the owner legal title (free of liens or encumbrances of any kind) to the material so stored or stockpiled.
- e. The Contractor has furnished the owner evidence that the material so stored or stockpiled is insured against loss by damage to or disappearance of such materials at anytime prior to use in the work.

It is understood and agreed that the transfer of title and the owner's payment for such stored or stockpiled materials shall in no way relieve the Contractor of his/her responsibility for furnishing and placing such materials in accordance with the requirements of the contract, plans, and specifications.

In no case will the amount of partial payments for materials on hand exceed the contract price for such materials or the contract price for the contract item in which the material is intended to be used.

No partial payment will be made for stored or stockpiled living or perishable plant materials.

The Contractor shall bear all costs associated with the partial payment of stored or stockpiled materials in accordance with the provisions of this subsection.

90-08 PAYMENT OF WITHHELD FUNDS. At the Contractor's option, he/she may request that the owner accept (in lieu of the 10 percent retainage on partial payments described in the subsection titled PARTIAL PAYMENTS of this section) the Contractor's deposits in escrow under the following conditions.

- a. The Contractor shall bear all expenses of establishing and maintaining an escrow account and escrow agreement acceptable to the owner.
- b. The Contractor shall deposit to and maintain in such escrow only those securities or bank certificates of deposit as are acceptable to the owner and having a value not less than the 10 percent retainage that would otherwise be withheld from partial payment.
- c. The Contractor shall enter into an escrow agreement satisfactory to the owner.
- d. The Contractor shall obtain the written consent of the surety to such agreement.

90-09 ACCEPTANCE AND FINAL PAYMENT. When the contract work has been accepted in accordance with the requirements of the subsection titled FINAL ACCEPTANCE of Section 50, the Engineer will prepare the final estimate of the items of work actually performed. The Contractor shall approve the Engineer's final estimate or advise the Engineer of his/her objections to the final estimate which are based on disputes in measurements or computations of the final quantities to be paid under the contract as amended by change order or supplemental agreement. The Contractor and the Engineer shall resolve all

disputes (if any) in the measurement and computation of final quantities to be paid within 30 calendar days of the Contractor's receipt of the Engineer's final estimate. If, after such 30-day period, a dispute still exists, the Contractor may approve the Engineer's estimate under protest of the quantities in dispute, and such disputed quantities shall be considered by the owner as a claim in accordance with the subsection titled CLAIMS FOR ADJUSTMENT AND DISPUTES of Section 50.

After the Contractor has approved, or approved under protest, the Engineer's final estimate, final payment will be processed based on the entire sum, or the undisputed sum in case of approval under protest, determined to be due the Contractor less all previous payments and all amounts to be deducted under the provisions of the contract. All prior partial estimates and payments shall be subject to correction in the final estimate and payment.

If the Contractor has filed a claim for additional compensation under the provisions of the subsection titled CLAIMS FOR ADJUSTMENTS AND DISPUTES of Section 50 or under the provisions of this subsection, such claims will be considered by the owner in accordance with local laws or ordinances. Upon final adjudication of such claims, any additional payment determined to be due the Contractor will be paid pursuant to a supplemental final estimate.

END OF SECTION 90

GENERAL PROVISIONS SECTION 110

**METHOD OF ESTIMATING PERCENTAGE OF MATERIAL
WITHIN SPECIFICATION LIMITS (PWL)**

~~110-01 GENERAL.~~ When the specifications provide for acceptance of material based on the method of estimating percentage of material within specification limits (PWL), the PWL will be determined in accordance with this section. All test results for a lot will be analyzed statistically to determine the total estimated percent of the lot that is within specification limits. The PWL is computed using the sample average (\bar{X}) and sample standard deviation (S_n) of the specified number (n) of sublots for the lot and the specification tolerance limits, L for lower and U for upper, for the particular acceptance parameter. From these values, the respective Quality index(s), QL for Lower Quality Index and/or QU for Upper Quality Index, is computed and the PWL for the lot for the specified n is determined from Table 1. All specification limits specified in the technical sections shall be absolute values. Test results used in the calculations shall be to the significant figure given in the test procedure.

There is some degree of uncertainty (risk) in the measurement for acceptance because only a small fraction of production material (the population) is sampled and tested. This uncertainty exists because all portions of the production material have the same probability to be randomly sampled. The Contractor's risk is the probability that material produced at the acceptable quality level is rejected or subjected to a pay adjustment. The Owner's risk is the probability that material produced at the rejectable quality level is accepted.

~~IT IS THE INTENT OF THIS SECTION TO INFORM THE CONTRACTOR THAT, IN ORDER TO CONSISTENTLY OFFSET THE CONTRACTOR'S RISK FOR MATERIAL EVALUATED, PRODUCTION QUALITY (USING POPULATION AVERAGE AND POPULATION STANDARD DEVIATION) MUST BE MAINTAINED AT THE ACCEPTABLE QUALITY SPECIFIED OR HIGHER. IN ALL CASES, IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO PRODUCE AT QUALITY LEVELS THAT WILL MEET THE SPECIFIED ACCEPTANCE CRITERIA WHEN SAMPLED AND TESTED AT THE FREQUENCIES SPECIFIED.~~

~~110-02 METHOD FOR COMPUTING PWL.~~ The computational sequence for computing PWL is as follows:

- a. ~~Divide the lot into n sublots in accordance with the acceptance requirements of the specification.~~
- b. ~~Locate the random sampling position within the subplot in accordance with the requirements of the specification.~~
- c. ~~Make a measurement at each location, or take a test portion and make the measurement on the test portion in accordance with the testing requirements of the specification.~~
- d. ~~Find the sample average (\bar{X}) for all subplot values within the lot by using the following formula:~~

$$\bar{X} = \frac{(x_1 + x_2 + x_3 + \dots + x_n)}{n}$$

~~Where: \bar{X} = Sample average of all subplot values within a lot
 x_1, x_2 = Individual subplot values
 n = Number of sublots~~

- e. ~~Find the sample standard deviation (S_n) by use of the following formula:~~

$$S_n = \sqrt{\frac{d_1^2 + d_2^2 + d_3^2 + \dots + d_n^2}{n-1}}$$

Where: S_n = Sample standard deviation of the number of subplot values in the set
 d_1, d_2, \dots = Deviations of the individual subplot values x_1, x_2, \dots from the average value X
 that is: $d_1 = (x_1 - X), d_2 = (x_2 - X) \dots d_n = (x_n - X)$
 n = Number of sublots

- f. For single sided specification limits (i.e., L only), compute the Lower Quality Index Q_L by use of the following formula:

$$Q_L = \frac{X - L}{S_n}$$

Where: L = specification lower tolerance limit

Estimate the percentage of material within limits (PWL) by entering Table 1 with Q_L , using the column appropriate to the total number (n) of measurements. If the value of Q_L falls between values shown on the table, use the next higher value of PWL.

- g. For double-sided specification limits (i.e. L and U), compute the Quality Indexes Q_L and Q_U by use of the following formulas:

$$Q_L = \frac{X - L}{S_n} \text{ and } Q_U = \frac{U - X}{S_n}$$

Where: L and U = specification lower and upper tolerance limits

Estimate the percentage of material between the lower (L) and upper (U) tolerance limits (PWL) by entering Table 1 separately with Q_L and Q_U , using the column appropriate to the total number (n) of measurements, and determining the percent of material above P_L and percent of material below P_U for each tolerance limit. If the values of Q_L fall between values shown on the table, use the next higher value of P_L or P_U . Determine the PWL by use of the following formula:

$$PWL = (P_U + P_L) - 100$$

Where: P_L = percent within lower specification limit
 P_U = percent within upper specification limit

EXAMPLE OF PWL CALCULATION

Project: Example Project

Test Item: Item P-401, Lot A.

A. PWL Determination for Mat Density.

- Density of four random cores taken from Lot A.

_____ A 1 _____ 96.60
 _____ A 2 _____ 97.55

~~———— A-3 ———— 99.30~~
~~———— A-4 ———— 98.35~~
~~———— n = 4~~

2. Calculate average density for the lot.

$$\bar{X} = \frac{(x_1 + x_2 + x_3 + \dots + x_n)}{n}$$

$$\bar{X} = \frac{96.60 + 97.55 + 99.30 + 98.35}{4}$$

$$\bar{X} = 97.95 \text{ percent density}$$

3. Calculate the standard deviation for the lot.

$$S_n = \sqrt{\frac{(96.60 - 97.95)^2 + (97.55 - 97.95)^2 + (99.30 - 97.95)^2 + (98.35 - 97.95)^2}{4 - 1}}$$

$$S_n = \sqrt{\frac{1.82 + 0.16 + 1.82 + 0.16}{3}}$$

$$S_n = 1.15$$

4. Calculate the Lower Quality Index Q_L for the lot. ($L=96.3$)

$$Q_L = \frac{\bar{X} - L}{S_n}$$

$$Q_L = \frac{97.95 - 96.30}{1.15}$$

$$Q_L = 1.4348$$

5. Determine PWL by entering Table 1 with $Q_L = 1.44$ and $n = 4$.

$$PWL = 98$$

B. PWL Determination for Air Voids.

1. Air Voids of four random samples taken from Lot A.

A-1 ——— 5.00
A-2 ——— 3.74
A-3 ——— 2.30
A-4 ——— 3.25

2. Calculate the average air voids for the lot.

$$\bar{X} = \frac{x_1 + x_2 + x_3 + \dots + x_n}{n}$$

$$\bar{X} = \frac{5.00+3.74+2.30+3.25}{4}$$

$$\bar{X} = 3.57 \text{ percent}$$

3. Calculate the standard deviation $S_{\bar{x}}$ for the lot.

$$S_{\bar{x}} = \sqrt{\frac{(3.57-5.00)^2 + (3.57-3.74)^2 + (3.57-2.30)^2 + (3.57-3.25)^2}{4-1}}$$

$$S_{\bar{x}} = \sqrt{\frac{2.04+0.03+1.62+0.10}{3}}$$

$$S_{\bar{x}} = 1.12$$

4. Calculate the Lower Quality Index Q_L for the lot. ($L=2.0$)

$$Q_L = \frac{\bar{X}-L}{S_{\bar{x}}}$$

$$Q_L = \frac{3.57-2.00}{1.12}$$

$$Q_L = 1.3992$$

5. Determine P_L by entering Table 1 with $Q_L=1.41$ and $n=4$.

$$P_L = 97$$

6. Calculate the Upper Quality Index Q_U for the lot. ($U=5.0$)

$$Q_U = \frac{U-\bar{X}}{S_{\bar{x}}}$$

$$Q_U = \frac{5.00-3.57}{1.12}$$

$$Q_U = 1.2702$$

7. Determine P_U by entering Table 1 with $Q_U=1.29$ and $n=4$.

$$P_U = 93$$

8. Calculate Air Voids PWL

$$PWL = (P_L + P_U) - 100$$

$$PWL = (97 + 93) - 100 = 90$$

EXAMPLE OF OUTLIER CALCULATION (Reference ASTM E 78)

Project: Example Project

Test Item: Item P-401, Lot A.

A. ~~Outlier Determination for Mat Density.~~

~~1. Density of four random cores taken from Lot A. arranged in descending order.~~

~~A-3 — 99.30~~

~~A-4 — 98.35~~

~~A-2 — 97.55~~

~~A-1 — 96.60~~

~~2. Use $n=4$ and upper 5 percent significance level of to find the critical value for test criterion = 1.463.~~

~~3. Use average density, standard deviation, and test criterion value to evaluate density measurements.~~

~~a. For measurements greater than the average:~~

~~If: $(\text{measurement} - \text{average}) / (\text{standard deviation})$ is less than test criterion,~~

~~Then: the measurement is not considered an outlier~~

~~for A-3 Check if $(99.30 - 97.95) / 1.15$ greater than 1.463~~

~~1.174 is less than 1.463, the value is not an outlier~~

~~b. For measurements less than the average:~~

~~If $(\text{average} - \text{measurement}) / (\text{standard deviation})$ is less than test criterion,~~

~~the measurement is not considered an outlier~~

~~for A-1 Check if $(97.95 - 96.60) / 1.15$ greater than 1.463~~

~~1.0 is less than 1.463, the value is not an outlier~~

~~NOTE: In this example, a measurement would be considered an outlier if the density was:~~

~~_____ greater than $(97.95 + 1.463 \times 1.15) = 99.63$ percent or,~~

~~_____ less than $(97.95 - 1.463 \times 1.15) = 96.27$ percent~~

TABLE 1. TABLE FOR ESTIMATING PERCENT OF LOT WITHIN LIMITS (PWL)

Percent Within Limits (P_L and P_U)	Values of Q (Q_L and Q_U)							
	n=3	n=4	n=5	n=6	n=7	n=8	n=9	n=10
99	1.1541	1.4700	1.6714	1.8008	1.8888	1.9520	1.9994	2.0362
98	1.1524	1.4400	1.6016	1.6982	1.7612	1.8053	1.8379	1.8630
97	1.1496	1.4100	1.5427	1.6181	1.6661	1.6993	1.7235	1.7420
96	1.1456	1.3800	1.4897	1.5497	1.5871	1.6127	1.6313	1.6454
95	1.1405	1.3500	1.4407	1.4887	1.5181	1.5381	1.5525	1.5635
94	1.1342	1.3200	1.3946	1.4329	1.4561	1.4717	1.4829	1.4914
93	1.1269	1.2900	1.3508	1.3810	1.3991	1.4112	1.4199	1.4265
92	1.1184	1.2600	1.3088	1.3323	1.3461	1.3554	1.3620	1.3670
91	1.1089	1.2300	1.2683	1.2860	1.2964	1.3032	1.3081	1.3118
90	1.0982	1.2000	1.2290	1.2419	1.2492	1.2541	1.2576	1.2602
89	1.0864	1.1700	1.1909	1.1995	1.2043	1.2075	1.2098	1.2115
88	1.0736	1.1400	1.1537	1.1587	1.1613	1.1630	1.1643	1.1653
87	1.0597	1.1100	1.1173	1.1192	1.1199	1.1204	1.1208	1.1212
86	1.0448	1.0800	1.0817	1.0808	1.0800	1.0794	1.0791	1.0789
85	1.0288	1.0500	1.0467	1.0435	1.0413	1.0399	1.0389	1.0382
84	1.0119	1.0200	1.0124	1.0071	1.0037	1.0015	1.0000	0.9990
83	0.9939	0.9900	0.9785	0.9715	0.9671	0.9643	0.9624	0.9610
82	0.9749	0.9600	0.9452	0.9367	0.9315	0.9281	0.9258	0.9241
81	0.9550	0.9300	0.9123	0.9025	0.8966	0.8928	0.8901	0.8882
80	0.9342	0.9000	0.8799	0.8690	0.8625	0.8583	0.8554	0.8533
79	0.9124	0.8700	0.8478	0.8360	0.8291	0.8245	0.8214	0.8192
78	0.8897	0.8400	0.8160	0.8036	0.7962	0.7915	0.7882	0.7858
77	0.8662	0.8100	0.7846	0.7716	0.7640	0.7590	0.7556	0.7531
76	0.8417	0.7800	0.7535	0.7401	0.7322	0.7271	0.7236	0.7211
75	0.8165	0.7500	0.7226	0.7089	0.7009	0.6958	0.6922	0.6896
74	0.7904	0.7200	0.6921	0.6781	0.6701	0.6649	0.6613	0.6587
73	0.7636	0.6900	0.6617	0.6477	0.6396	0.6344	0.6308	0.6282
72	0.7360	0.6600	0.6316	0.6176	0.6095	0.6044	0.6008	0.5982
71	0.7077	0.6300	0.6016	0.5878	0.5798	0.5747	0.5712	0.5686
70	0.6787	0.6000	0.5719	0.5582	0.5504	0.5454	0.5419	0.5394
69	0.6490	0.5700	0.5423	0.5290	0.5213	0.5164	0.5130	0.5105
68	0.6187	0.5400	0.5129	0.4999	0.4924	0.4877	0.4844	0.4820
67	0.5878	0.5100	0.4836	0.4710	0.4638	0.4592	0.4560	0.4537
66	0.5563	0.4800	0.4545	0.4424	0.4355	0.4310	0.4280	0.4257
65	0.5242	0.4500	0.4255	0.4139	0.4073	0.4030	0.4001	0.3980
64	0.4916	0.4200	0.3967	0.3856	0.3793	0.3753	0.3725	0.3705
63	0.4586	0.3900	0.3679	0.3575	0.3515	0.3477	0.3451	0.3432
62	0.4251	0.3600	0.3392	0.3295	0.3239	0.3203	0.3179	0.3161
61	0.3911	0.3300	0.3107	0.3016	0.2964	0.2931	0.2908	0.2892
60	0.3568	0.3000	0.2822	0.2738	0.2691	0.2660	0.2639	0.2624
59	0.3222	0.2700	0.2537	0.2461	0.2418	0.2391	0.2372	0.2358
58	0.2872	0.2400	0.2254	0.2186	0.2147	0.2122	0.2105	0.2093
57	0.2519	0.2100	0.1971	0.1911	0.1877	0.1855	0.1840	0.1829
56	0.2164	0.1800	0.1688	0.1636	0.1607	0.1588	0.1575	0.1566
55	0.1806	0.1500	0.1406	0.1363	0.1338	0.1322	0.1312	0.1304
54	0.1447	0.1200	0.1125	0.1090	0.1070	0.1057	0.1049	0.1042
53	0.1087	0.0900	0.0843	0.0817	0.0802	0.0793	0.0786	0.0781
52	0.0725	0.0600	0.0562	0.0544	0.0534	0.0528	0.0524	0.0521
51	0.0363	0.0300	0.0281	0.0272	0.0267	0.0264	0.0262	0.0260
50	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Percent Within Limits (P_L and P_U)	Values of Q (Q_L and Q_U)							
	n=3	n=4	n=5	n=6	n=7	n=8	n=9	n=10
49	-0.0363	-0.0300	-0.0281	-0.0272	-0.0267	-0.0264	-0.0262	-0.0260
48	-0.0725	-0.0600	-0.0562	-0.0544	-0.0534	-0.0528	-0.0524	-0.0521
47	-0.1087	-0.0900	-0.0843	-0.0817	-0.0802	-0.0793	-0.0786	-0.0781
46	-0.1447	-0.1200	-0.1125	-0.1090	-0.1070	-0.1057	-0.1049	-0.1042
45	-0.1806	-0.1500	-0.1406	-0.1363	-0.1338	-0.1322	-0.1312	-0.1304
44	-0.2164	-0.1800	-0.1688	-0.1636	-0.1607	-0.1588	-0.1575	-0.1566
43	-0.2519	-0.2100	-0.1971	-0.1911	-0.1877	-0.1855	-0.1840	-0.1829
42	-0.2872	-0.2400	-0.2254	-0.2186	-0.2147	-0.2122	-0.2105	-0.2093
41	-0.3222	-0.2700	-0.2537	-0.2461	-0.2418	-0.2391	-0.2372	-0.2358
40	-0.3568	-0.3000	-0.2822	-0.2738	-0.2691	-0.2660	-0.2639	-0.2624
39	-0.3911	-0.3300	-0.3107	-0.3016	-0.2964	-0.2931	-0.2908	-0.2892
38	-0.4251	-0.3600	-0.3392	-0.3295	-0.3239	-0.3203	-0.3179	-0.3161
37	-0.4586	-0.3900	-0.3679	-0.3575	-0.3515	-0.3477	-0.3451	-0.3432
36	-0.4916	-0.4200	-0.3967	-0.3856	-0.3793	-0.3753	-0.3725	-0.3705
35	-0.5242	-0.4500	-0.4255	-0.4139	-0.4073	-0.4030	-0.4001	-0.3980
34	-0.5563	-0.4800	-0.4545	-0.4424	-0.4355	-0.4310	-0.4280	-0.4257
33	-0.5878	-0.5100	-0.4836	-0.4710	-0.4638	-0.4592	-0.4560	-0.4537
32	-0.6187	-0.5400	-0.5129	-0.4999	-0.4924	-0.4877	-0.4844	-0.4820
31	-0.6490	-0.5700	-0.5423	-0.5290	-0.5213	-0.5164	-0.5130	-0.5105
30	-0.6787	-0.6000	-0.5719	-0.5582	-0.5504	-0.5454	-0.5419	-0.5394
29	-0.7077	-0.6300	-0.6016	-0.5878	-0.5798	-0.5747	-0.5712	-0.5686
28	-0.7360	-0.6600	-0.6316	-0.6176	-0.6095	-0.6044	-0.6008	-0.5982
27	-0.7636	-0.6900	-0.6617	-0.6477	-0.6396	-0.6344	-0.6308	-0.6282
26	-0.7904	-0.7200	-0.6921	-0.6781	-0.6701	-0.6649	-0.6613	-0.6587
25	-0.8165	-0.7500	-0.7226	-0.7089	-0.7009	-0.6958	-0.6922	-0.6896
24	-0.8417	-0.7800	-0.7535	-0.7401	-0.7322	-0.7271	-0.7236	-0.7211
23	-0.8662	-0.8100	-0.7846	-0.7716	-0.7640	-0.7590	-0.7556	-0.7531
22	-0.8897	-0.8400	-0.8160	-0.8036	-0.7962	-0.7915	-0.7882	-0.7858
21	-0.9124	-0.8700	-0.8478	-0.8360	-0.8291	-0.8245	-0.8214	-0.8192
20	-0.9342	-0.9000	-0.8799	-0.8690	-0.8625	-0.8583	-0.8554	-0.8533
19	-0.9550	-0.9300	-0.9123	-0.9025	-0.8966	-0.8928	-0.8901	-0.8882
18	-0.9749	-0.9600	-0.9452	-0.9367	-0.9315	-0.9281	-0.9258	-0.9241
17	-0.9939	-0.9900	-0.9785	-0.9715	-0.9671	-0.9643	-0.9624	-0.9610
16	-1.0119	-1.0200	-1.0124	-1.0071	-1.0037	-1.0015	-1.0000	-0.9990
15	-1.0288	-1.0500	-1.0467	-1.0435	-1.0413	-1.0399	-1.0389	-1.0382
14	-1.0448	-1.0800	-1.0817	-1.0808	-1.0800	-1.0794	-1.0791	-1.0789
13	-1.0597	-1.1100	-1.1173	-1.1192	-1.1199	-1.1204	-1.1208	-1.1212
12	-1.0736	-1.1400	-1.1537	-1.1587	-1.1613	-1.1630	-1.1643	-1.1653
11	-1.0864	-1.1700	-1.1909	-1.1995	-1.2043	-1.2075	-1.2098	-1.2115
10	-1.0982	-1.2000	-1.2290	-1.2419	-1.2492	-1.2541	-1.2576	-1.2602
9	-1.1089	-1.2300	-1.2683	-1.2860	-1.2964	-1.3032	-1.3081	-1.3118
8	-1.1184	-1.2600	-1.3088	-1.3323	-1.3461	-1.3554	-1.3620	-1.3670
7	-1.1269	-1.2900	-1.3508	-1.3810	-1.3991	-1.4112	-1.4199	-1.4265
6	-1.1342	-1.3200	-1.3946	-1.4329	-1.4561	-1.4717	-1.4829	-1.4914
5	-1.1405	-1.3500	-1.4407	-1.4887	-1.5181	-1.5381	-1.5525	-1.5635
4	-1.1456	-1.3800	-1.4897	-1.5497	-1.5871	-1.6127	-1.6313	-1.6454
3	-1.1496	-1.4100	-1.5427	-1.6181	-1.6661	-1.6993	-1.7235	-1.7420
2	-1.1524	-1.4400	-1.6016	-1.6982	-1.7612	-1.8053	-1.8379	-1.8630
1	-1.1541	-1.4700	-1.6714	-1.8008	-1.8888	-1.9520	-1.9994	-2.0362

END OF SECTION 110

SPECIAL PROVISIONS

BID DOCUMENTS
HANGAR DEVELOPMENTS
MARIANNA MUNICIPAL AIRPORT, MARIANNA, FLORIDA

SPECIAL PROVISION NO. 1

UTILITIES

A. Description

The Contractor shall be responsible for the coordination and associated costs to protect existing facilities, utilities and features that may be impacted by the project.

B. General

Existing facilities, utilities and features depicted on the construction plans are not guaranteed to be accurate with respect to location, depth, condition or characteristics. Also, there may be additional facilities and features existing that could affect the construction of this project, which are not depicted or described in the construction plans. Prior to bidding, the Contractor shall make a thorough investigation of the project area to satisfy himself/herself as to the location, condition and characteristics of any and all facilities and features, which may affect the work. No additional compensation will be made for any extra expense relating to an existing facility or feature. The Contractor hereby agrees to make no claims against the Owner, the Engineer, and their representatives relating to the existence or lack thereof, location, condition and/or characteristics of any existing facilities or features

C. Protection of Existing Utilities

Airfield lighting cables; electric power lines; telephone lines; computer cables; airport power and control cables; transmission and distribution water lines; and sanitary force mains may be located in the areas of construction. Disruption of these utilities could seriously disrupt the operation of the airport. Actual locations are uncertain, and the Contractor is required to verify all locations.

Power and control cables leading to and from any Nav aids and other facilities shall be protected from any possible damage, including crossing with unauthorized equipment, etc. No grading will be permitted over the cables under any conditions unless shown on the drawings or approved by the Engineer. These provisions intend to make perfectly clear the need for protection of Nav aids and other facility cables by the Contractor at all times.

If damage occurs to any utilities, the Contractor may be assessed a fee of \$2,000 liquidated damages per cut, which shall only represent the expense incurred by the Owner in coordinating the repair, and which shall not prevent the Owner or others from recovering from the Contractor costs or expenses of any other nature due to damages to utilities. The Contractor will also reimburse the appropriate utility owner for all material and labor costs to repair damaged utilities.

It is understood and agreed that the Owner does not guarantee the accuracy or the completeness of the location information relating to existing utility services, facilities or structures that may be shown on the exhibits or encountered in the work. Any inaccuracy or omission in such information will not relieve Contractor of his responsibility to protect such existing features from damage or unscheduled interruption of service.

It is further understood and agreed that the Contractor shall, upon execution of the contract, notify

the Owner of all utility services or other facilities of his plan of operations. Such notification shall be in writing addressed to the appropriate point-of-contact as provided herein. A copy of each notification shall be given to the Engineer.

In addition to the general written notification provided, it shall be the responsibility of the Contractor to keep such individual Owners advised of changes in his plan of operation that would affect such Owners.

Prior to commencing the work in the general vicinity of an existing utility service or facility, the Contractor shall again notify each such Owner in writing, through the Project Manager, of the plan of operations. If, in the Contractor's opinion, the Owner's assistance is needed to locate the utility service or facility or the presence of a representative of the Owner is desirable to observe the work, such advice should be included in the written notification. Such notification shall be given through the Project Manager by the most expeditious means to reach the utility Owners point-of-contact no later than two normal business days prior to the Contractor's commencement of operations in such general vicinity. The Contractor's failure to give two (2) days notice shall be cause for the Project Manager to suspend construction operations in the general vicinity of a utility service or facility.

Where the outside limits of an underground utility service have been located and staked on the ground, the Contractor shall be required to use excavation methods acceptable to the Project Manager within three (3) feet of the outside limits, at such points as may be required to insure protection from damage due to the Contractors operations. Excavation methods could include the use of hand digging tools, the use of non-ferrous hand tools and could exclude the use of long-handled metal spades.

Should the Contractor damage or interrupt the operation of a utility service or facility by accident or otherwise, he shall immediately notify the proper utility company and the Project Manager and shall take all reasonable measures to prevent further damage or interruption of service. The Contractor, in such events, shall cooperate with the utility service or facility-Owner and the Project Manager continuously until such damage has been repaired and service restored to the satisfaction of the utility or facility Owner.

The Contractor shall bear all direct and indirect costs of damage and restoration of service to any utility service or facility due to his operations, whether or not due to negligence or accident. The Owner reserves the right to deduct such costs from any monies due or which may become due the Contractor or his surety.

Airport owned facilities and properties and privately owned facilities located on airport property, including underground cables, pavements, piping, buildings, turfed areas, vehicles and other facilities/improvements, that are damaged by the Contractor shall, at the election of the Owner, (1) be replaced/repaired by the Contractor to the satisfaction of the Owner or (2) be replaced/repaired by the Owner at the Contractor's expense.

All utilities not shown in the plans and found by the Contractor shall be recorded by the Contractor and submitted to the Airport Manager or Project Manager as Record Drawings. Refer to Special Provision No. 7 for additional requirements for Record Drawings.

END OF SP-1

**SPECIAL PROVISION NO. 2
AIRPORT PROJECT PROCEDURES**

A. Permits

Contractor shall be required to procure and pay for all construction permits if required, and arrange for all inspections and similar procedural items as required by the code enforcement authorities having jurisdiction.

B. Airport Operations

Airport operations shall be maintained throughout this Contract. The Contractor shall in no way curtail or handicap normal operational characteristics of the airport facility except as specifically indicated and specified in these Contract Documents.

C. Limits of Construction

Any surface graded or disturbed outside the construction limits as shown on the plans will be restored and sodded or seeded and mulched as directed by the Engineer at the Contractor's expense.

D. Construction Layout and Stakes

Contractor shall furnish all lines, grades and measurements necessary for the proper prosecution and control of the work and contracted for under these specifications. The Contractor will establish horizontal and vertical control points only. Contractor is thereafter responsible to maintain these control points for use by subsequent contractors.

E. Verification of Existing Conditions

Prior to bidding and commencing with construction, the Contractor shall familiarize himself as to the existing conditions. Should the Contractor discover any inaccuracies, errors or omissions between the actual existing conditions and the Contract Documents, he shall within seven (7) calendar days prior to Bid Opening, notify the Engineer in writing. Submission of Bid by the Contractor shall be held as an acceptance of the existing conditions by the Contractor.

F. Safety and Protection

1. **Safety:** Inasmuch as each work area will be accessible to and used by the public, the Owner and other companies doing business at the Airport during the construction period, it is the Contractor's responsibility to maintain each work area in a safe, hazard free condition at all times. Should the Owner find the area unsafe at any time, they will notify the Contractor, and the Contractor shall take whatever steps necessary to remedy the unsafe condition. Should the Contractor not be immediately available for corrective action, the Owner will remedy the problem and the Contractor shall reimburse the Owner for the expense of such correction.
2. **Protection of Property:** Fixed structures, equipment, paving, landscaping and vehicles (automobiles, trucks, etc.) shall be protected with drop cloths, shielding and other appropriate measures to ensure maximum protection of all property and vehicles.

G. Pre-Construction Conference

Before beginning work at the site, the Contractor shall attend a pre-construction conference and bring with him the superintendent employed for this project. In the event the Contractor is unable to attend, he shall send a letter of introduction with the superintendent in which he advises the superintendent's full name and states that he is assigned to the project and will be in full responsible

charge. This conference will be called by the Engineer, who will arrange for the Owner's representative and other interested parties to be present. At this time, all parties will discuss the project under contract and prepare a program of procedure in keeping with requirements of the drawings and specifications. The superintendent will henceforth make every effort to expeditiously coordinate all phases of the work, including the required reporting procedure, to obtain the end result within the full purpose and intent of the drawings and specifications for the project.

H. Coordination and Progress Meetings

1. Weekly Coordination and Progress Meetings: The Contractor / Engineer will hold weekly general project coordination and progress meetings at regularly scheduled times convenient for all parties involved. These meetings are in addition to specific meetings held for other purposes, such as special project meetings and special pre-installation meetings. The Engineer will require representation at each meeting by every party currently involved in coordination or planning for the work of the entire project. Meetings will be conducted in a manner which will resolve coordination problems.
2. The Engineer will record results of the meeting and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

I. Administrative/Supervisory Personnel

The Contractor shall provide a full-time Project Management Team consisting of a Contractor's Engineer, Project Superintendent and other supervisory personnel for the duration of the Project. The names and qualifications of this team for this work shall be submitted to the Owner as part of the Bidder Qualification Form. They shall have a minimum of five (5) years of experience on suitable projects of equal difficulty. Either the Contractor's Engineer or the Project Superintendent shall be at the construction site at all periods when work is in progress. This person shall have full authority to act in the Contractor's behalf. It is agreed and understood that, if requested in writing by the Owner, the Contractor shall replace any member of the team with another meeting the required qualifications within three (3) days of the receipt of the request.

J. Special Reports

1. Reporting Unusual Events: When an event of an unusual and significant nature occurs at the site, the Contractor shall prepare and submit a special report to the Engineer. List chain of events, persons participating, response by the Contractor's personnel, an evaluation of the results or effects and similar pertinent information. Advise the Owner and Engineer as soon as possible when such events are known.
2. Submit special reports directly to the Owner within one day of occurrence. Submit a copy of the report to the Engineer and other entities that are affected by the occurrence within one day of the occurrence.

K. Schedule of Work

1. Prepare and submit, in triplicate, for the Engineer's information, progress schedules for the work.
2. Progress schedules shall relate to the entire project to the extent required by the Contract Documents and shall provide for expeditious and practicable execution of the work.
3. Progress schedules shall be updated monthly.

4. Percent complete shall be based on actual construction in place or dollar volume of the work. If dollar volume of the work reflects the greater percent complete, the maximum percent complete shall in no case exceed 5 percent of the value of the in-place construction.

L. Progress Schedule

1. Preliminary Schedule: Within 15 days after date of Notice of Award and Acceptance or at the Pre-Construction Conference, whichever is earlier, the Contractor shall submit his preliminary network phasing diagram (Preliminary Schedule) indicating a comprehensive overview of the Project including an activity line for each of the work segments to be performed at the site.
 - a. Arrange the schedule to indicate required sequencing of work and to show time allowances for submittals, inspections, and similar time margins.
 - b. The submitted schedule will be reviewed by the Engineer and Owner for conformance to Critical Dates and overall project completion time criteria. Lack of this information will be cause for rejection of the schedule.
 - c. Following initial submittal of the schedule to and response by the Engineer, print and distribute the Progress Schedule to entities with a need-to-know responsibility, including three (3) copies to the Engineer. Revise at intervals matching payment requests, and redistribute and repost. Provide the copies required with payment requests.

M. Maintenance of Schedule

The Contractor's Progress Schedule must be updated on a monthly basis, and a copy thereof submitted with each of the Contractor's Applications for Payment. The updated Progress Schedule shall not only indicate revisions to the Schedule for upcoming work but show "as-built" schedule progress data. The Engineer will not recommend for payment by the Owner an Application for Payment without the Contractor's submission of a Monthly Schedule Update.

1. If the Contractor's Monthly Schedule Update reflects, or the Engineer determines, that the Contractor is at least ten percent (10%) behind the original Progress Schedule or fourteen (14) or more calendar days behind the original Progress Schedule for:
 - a. the work as a whole;
 - b. a major Contract item;
 - c. an item of work which is on the critical path; or
 - d. an item of work not on the original critical path that, because of the delay or anticipated delay became a critical path item;

then the Contractor must submit with the Monthly Schedule Update his proposed plan for bringing the work back on schedule and completing the Work within the Contract time.

2. The Progress Schedule shall be coordinated by the Owner's Project Administrator with the overall schedule for the Airport Projects. The Contractor is required to revise the Progress Schedule promptly in accordance with the conditions of the work, subject to approval by the Owner's Project Coordinator and the Engineer.

3. The Contractor shall comply fully with all time and other requirements of the Contract Documents. Recommendation of an Application of Payment by the Engineer and payment thereon by the Owner, without the submission of a Monthly Schedule Update, shall not constitute a waiver of the requirements of such updates, nor shall it relieve the Contractor from the obligation to complete the Work within the Contract Time.
4. Should a review of work indicate a critical path (milestone) item has fallen behind the approved schedule, at the option of the Engineer, funds equal to the established liquidated damages for the number of calendar days behind schedule will be withheld until that critical path item is brought back on schedule.

N. Changes in the Schedule

1. Minor Changes: Each week, prior to the weekly coordination meeting during the time of the contract, the Contractor shall notify the Engineer and Engineer of any minor changes that are anticipated in the schedule for the following week.
2. Major Changes: If for any reason a major change in the approved schedule is anticipated, the Contractor shall make the necessary changes to the schedule and resubmit the revised schedule for approval.

Copies of the approved schedule shall be posted in the Contractor's field office with completed work identified in colored pencil.

O. Maintenance of Traffic

1. The Contractor shall not obstruct nor create a hazard to any traffic during the prosecution of the work and shall be responsible for repair of all damage to existing pavement or facilities caused by his operations.
2. Beginning date of Contractor's Responsibility: The Contractor's responsibility for maintenance of traffic shall begin on the day he starts the work and continue until Final Completion and Acceptance of the Project.
3. Sections Not Requiring Traffic Maintenance: The Contractor will not be required to maintain traffic over those portions of the Project where no work is to be accomplished or where construction operations will not affect aircraft operations. The Contractor, however, shall not obstruct nor create a hazard to any traffic during the prosecution of the work and shall be responsible for repair of any damage to existing pavement or facilities caused by his operations.
4. Traffic During Construction: All construction vehicles are required to use existing traffic routes. Normal traffic lanes are not to be used as staging areas for arriving delivery vehicles. The Contractor's employees shall utilize the designated Contractor employee parking area.
5. Contractor Signing: The Contractor may furnish and install construction traffic directional signs along the existing traffic route. The signs shall depict Contractor's logo or name, directional arrows and "deliveries". Signs shall be of sufficient size to have 6" high message and shall be located at each decision point. All signs and their locations shall be approved by the Engineer. NO OTHER SIGNS ARE PERMITTED.

6. Material Deliveries: The Contractor shall make his own material and equipment deliveries. No deliveries shall be made by vendors or suppliers without escort by a representative of the Contractor.
 7. Notification: On days when construction traffic is expected to be extra heavy or when oversized pieces of equipment are to be delivered, give minimum forty-eight (48) hours notice to the Engineer.
 8. All Contractor material orders for the work site shall be delivered to the areas designated as the Contractor's receiving area. All deliveries shall be made only during the Contractor's working hours.
 9. Interference Request:
 - a. The Contractor shall be responsible for notifying the Owner in writing and securing approval for any and all interruptions or interference with traffic (pedestrian, automobile or other necessary function of the Airport).
 - b. The request shall include a traffic control plan indicating barricades, lighting and flagger where required.
 - c. Such notification shall be made as soon as possible but in no case less than 48 hours prior to interference.
 - d. It is suggested that the Contractor utilize a standard form addressed to the Owner with a blank space for a description of the interference, the exact area affected, the exact times and dates the interference will take place and blanks for the Owner's approval. The forms shall be submitted in duplicate. No interference will be allowed until the Contractor has received back a copy of the approved interference request form.
 10. Personnel Traffic:
 - a. General: All construction personnel shall be restricted to construction areas. They shall wear shirts with sleeves and long pants at all times.
 - b. Use of Public Areas: The Contractor's workmen shall not utilize public areas for taking their "work breaks" or "lunch breaks." Areas for this purpose can be designated by the Owner upon request. No Public Toilets shall be used by any workmen at any time.
- P. Daily Clean-Up and Trash Removal
1. Debris from this work shall be promptly removed from the site at least daily. It shall not be allowed to become a hazard to the safety of the public.
 2. The Contractor shall be responsible for clean-up and trash removal. Accumulation of trash and debris will not be allowed and the Engineer may at any time direct the Contractor to immediately remove his trash and debris from the site of the work when in the opinion of the Owner such trash constitutes a nuisance or in any way hinders the work or the Airports operations. If the Contractor should fail to remove his trash and debris from the site of the work in a timely manner, the Owner may have this work performed and deduct the cost of such from Contractor's payment.

Q. Cleaning and Protection

1. General: During handling and installation of work at the project site, clean and protect work in progress and adjoining work on the basis of continuous daily maintenance. Apply protective covering on installed work to ensure freedom from damage or deterioration.
2. Clean and perform maintenance on installed work as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
3. Limiting Exposures of Work: To the extent possible through appropriate control and protection methods, supervise performance of the work in such a manner and by such means which will ensure that none of the work, whether completed or in progress, will be subjected to harmful, dangerous, damaging or otherwise deleterious exposure during the construction period. Such exposures include, where applicable, but not by way of limitation the following:
 - a. Excessive static or dynamic loading
 - b. Excessive internal or external pressures
 - c. Solvents
 - d. Chemicals
 - e. Light
 - f. Puncture
 - g. Abrasion
 - h. Heavy Traffic
 - i. Soiling
 - j. Combustion
 - k. High speed operation, improper lubrication, unusual wear
 - l. Improper shipping or handling
 - m. Theft
 - n. Vandalism
4. Protection at Openings: The Contractor shall provide protection at all openings in structures and finishes to maintain the building weather and dust tight. All protection shall be of solid material and substantial so that it will not be disturbed by wind and weather normal to the area and season, and also tight fitting to prevent noise infiltration.
5. Protection of Improvements:
 - a. Damage to Existing Facilities: Existing surfaces and materials of the Owner's property not requiring work by the Contract Documents that is damaged by the Contractor's operations shall be immediately repaired. Repaired surfaces and materials shall match existing adjacent undamaged surfaces and materials. Repair work shall be coordinated with the Engineer and Owner with regard to time and method.
 - b. Accidental Demolition: All structures or parts thereof that may become damaged due to accident or Contractor's error shall be restored to their original condition at no cost to the Owner. Materials and equipment being used in the repair or replacement resulting from damage shall be new and shall perform at the manufacturer's published capacities. If the existing equipment or materials cannot be identified, or if unavailable, the selection of the replacement will be subject to approval by the Engineer in writing.

6. Overhead Protection
 - a. No cranes or other construction equipment shall cross over non-construction personnel, their travel ways or ride systems.
 - b. The plan of operation of cranes and other hoisting equipment shall be established in writing by the Contractor. This plan of operation shall be subject to approval by the Engineer.

R. Conservation and Salvage

General: It is a requirement for supervision and administration of the Work that construction operations be carried out with the maximum possible consideration given to conservation of energy, water and materials. In addition, maximum consideration shall be given to salvaging materials and equipment involved in performance of the work but not incorporated therein. Refer to other sections for required disposition of salvaged materials which are the Owner's property.

S. Testing Cost Borne by Owner

Unless otherwise specified herein, all initial construction "Quality Assurance" testing costs shall be borne by the Owner. An independent testing laboratory selected and responsible to the Engineer shall perform all "Quality Assurance" testing required by the technical specifications or as directed by the Owner and/or the Engineer.

T. Testing Cost Borne by Contractor

The Contractor shall bear the cost of all "Quality Control" testing to include the following conditions:

1. If substitute materials or equipment are proposed by the Contractor, he shall pay the cost of all tests which may be necessary to satisfy the Engineer that specification requirements are satisfied. The Contractor shall pay for the Engineer's time spent in review and administrating such proposed substitution.
2. If materials or workmanship are used which fail to meet specification requirements, the Contractor shall pay the cost of all re-testing, including laboratory costs, deemed necessary by the Engineer to determine the safety or suitability of the material or element. The Contractor shall make arrangements with the Owner's Testing Laboratory to have all re-testing costs billed directly to the Contractor, or deducted from amounts due to the Contractor unless otherwise directed by the Engineer in writing. The Contractor shall take prompt action to insure that all re-testing costs are paid in a reasonable time period.
3. The Contractor shall pay for all testing costs including, but not limited to, power, fuel, and equipment cost, which may be required for complete testing of all equipment and systems for proper operation.
4. The Contractor shall pay for all testing required for materials, job mix designs, equipment, structures and related items included in all shop drawings and other submittals as required by the Technical Specifications to be submitted and approved by the Engineer prior to construction.
5. The Contractor shall bear all costs necessary for the Quality Control testing as stipulated in General Provisions Section 100.

U. Project Documentation

1. Project Drawings: The successful Contractor will be furnished, at no charge, four (4) copies of drawings and specifications. Additional copies may be purchased at actual cost of reproduction.

A field set of drawings and specifications shall remain on the job site at all times and shall be available at all times to the Engineer. The field set shall be continuously updated to reflect the "as-built" condition of all work included in this Contract.

The Contractor shall immediately include plainly and conspicuously on the field set of drawings, and at appropriate paragraphs in the specifications, all changes or corrections made by addenda and change orders as they are issued.

Approved copies of all shop drawings and other submittals are to be kept on the job site at all times and shall be available at all times to the Engineer.

Changes and deviations from the existing conditions shall be submitted in writing for approval prior to installation. In no case shall any unspecified equipment or materials be installed without prior approval by the Engineer.

2. Record Documents:

- a. Definition: Record copies are defined to include those documents or copies relating directly to performance of the work, which the Contractor is required to prepare or maintain for the Owner's records, recording the work as actually performed. In particular, record copies show changes in the work in relation to the way in which work was shown and specified by the original contract documents and show additional information of value to the Owner's records but not indicated by the original Contract Documents.

Record copies include newly-prepared drawings (if any are specified), marked-up copies of contract drawings, shop drawings, specifications, addenda and change orders, marked-up product data submittals, record samples, field records for variable and concealed conditions such as excavations and foundations, and miscellaneous record information on work which is otherwise recorded only schematically or not at all.

- b. Record Drawings: The Contractor shall maintain a set of Record Drawings at the job site. These shall be kept legible and current and shall be available for inspection at all times by the Engineer. Show all changes or work added on these Record Drawings in a contrasting color.

- (1) Mark-up Procedure: During progress of the work, maintain a white-print set (blue-line or black-line) of contract drawings and shop drawings, with mark-up of actual installations which vary substantially from the work as originally shown. Mark whatever drawing is most capable of showing actual physical condition, fully and accurately. Where shop drawings are marked up, mark cross-reference on contract drawings at corresponding location. Mark with erasable colored pencil, using separate colors where feasible to distinguish between changes for different categories of work at the same general location. Mark-up important additional information, which was either shown schematically or omitted from original drawings. Give particular attention to information on work concealed, which would be difficult to identify or measure and record at a later date. Note alternate numbers, change order numbers and similar identification. Require

each person preparing the mark-up to initial and date the mark-up and indicate the name of the firm. Label each sheet "PROJECT RECORD" in 1-1/2 inch high letters.

In showing changes in the work, use the same legends as used on the original drawings. Indicate exact locations by dimensions and exact elevations by job datum. Give dimensions from a permanent point.

- (2) Preparation of Transparencies: In preparation for certification of substantial completion on the last major portion of the work, review the completed mark-up of record drawings and shop drawings with the Engineer. The Engineer will then proceed with preparation of a full set of corrected transparencies for contract drawings. The Engineer will date each updated drawing and label each sheet "PROJECT RECORD" in 1-1/2 inch high letters. Printing as required herein is the responsibility of the Engineer.
 - (3) Copies, Distribution: Upon completion of transparency record drawings, the Engineer shall prepare three blueline or blackline prints of each drawing, regardless of whether changes and additional information were recorded thereon. The Engineer shall then organize each of the three copies into manageable sets, bind with durable paper cover sheets, and print suitable titles and dates. The mark-up set of prints maintained during the construction period shall be bound in the same manner. The Engineer will retain one copy set. At the completion of the project, the Engineer shall submit one set of mylars and one set of prints with changes noted thereon to the Owner.
- c. Record Drawings shall contain the names, addresses and phone numbers of the General Contractor and the major subcontractors.
 - d. The Engineer shall be the sole judge of the acceptability of the Record Drawings. Receipt and acceptance of the As-Built drawings is a pre-requisite for Final Payment.
3. Record Specifications
 - a. During the progress of the work, maintain one copy of specifications, including addenda, change orders and similar modifications issued in printed form during construction. Mark-up variations (of substance) in actual work in comparison with text of specifications and modifications as issued. Give particular attention to substitutions, selection of options, and similar information on work where it is concealed or cannot otherwise be readily discerned at a later date by direct observation. Note related record drawing information and product data where applicable. Upon completion of the mark-up, submit to the Engineer for the Owner's records. Label the front cover "PROJECT RECORD" in 1-1/2 inch high letters.
 - b. Where the manual is printed on one side of the page only, mark variations on the blank left-hand pages of the Project Manual, facing printed right-hand pages containing original text affected by variation.
 4. Record Product Data
During progress of the work, maintain one copy of each product data submittal and mark up significant variations in the actual work in comparison with submitted information. Include both variations in product as delivered to site and variations from the manufacturer's instructions and recommendations for installation. Give particular attention to concealed products and portions

of the work which cannot otherwise be readily discerned at a later date by direct observation. Note related change orders and mark-ups of record drawings and specifications. Upon completion of the mark-up, submit a complete set of product data submittals to the Engineer for the Owner's records. Label each data submittal "PROJECT RECORD" in 1-1/2 inch high letters.

5. Record Sample Submittal

Immediately prior to the date(s) of substantial completion, the Engineer and Owner's personnel will meet with the Contractor on site and will determine if any of the submitted samples maintained by the Contractor during progress of the work are to be transmitted to the Owner for record purposes. Comply with the Engineer's instructions for packaging, identification marking and delivery to the Owner's sample storage space. Dispose of other samples in the manner specified for disposal of surplus and waste materials, unless otherwise indicated by the Engineer.

6. Miscellaneous Record Submittals

Refer to other sections of these specifications for requirements of miscellaneous record-keeping and submittals in connection with actual performance of the work. Immediately prior to the date(s) of substantial completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for continued use and reference. Submit to the Engineer for the Owner's records. Categories of requirements resulting in miscellaneous work records are recognized to include, but are not limited to, the following:

- a. Required field records on excavations, foundations, underground construction, wells and similar work.
- b. Accurate survey showing locations and elevations of underground lines, including invert elevations of drainage piping, valves, tanks and manholes.
- c. Surveys by a Registered Land Surveyor establishing lines and levels of finished construction.
- d. Soil treatment certification.
- e. Inspection and Test Reports: Where not processed as shop drawings or product data.
- f. Asphalt or PCC concrete pavement or structural mix design record.
- g. Concrete block certification.

7. Project Closeout

Closeout is hereby defined to include general requirements near end of Contract Time, in preparation for final acceptance, final payment, normal termination of contract, occupancy by the Owner and similar actions evidencing completion of the work. Specific requirements for individual units of work are specified in other sections. Time of closeout is directly related to substantial completion, and therefore may be a single time period for the entire work or a series of time periods for individual parts of the work which have been certified as substantially complete at different dates. The time variation, if any, shall be applicable to other provisions of this section.

8. Prerequisites to Substantial Completion

- a. Prior to requesting the Engineer's inspection for certification of substantial completion, for either the entire work or portions thereof, complete the following and list known exceptions in request:
 - (1) In the progress payment request coincident with or first following the date claimed, show 100% completion for the portion of work claimed as "substantially completed", or list incomplete items, value of incompleteness, and reasons for being incomplete.
 - (2) Include supporting documentation for completion as indicated in the Contract Documents.
 - (3) Submit statement showing accounting of changes to the Contract Sum.
 - (4) Advise the Owner of pending insurance change-over requirements.
 - (5) Obtain and submit releases enabling the Owner's full and unrestricted use of the work and access to services and utilities, including, where required, occupancy permits, operating certificates, and similar releases.
 - (6) Deliver tools, spare parts, extra stocks of materials, and similar physical items to the Owner.
 - (7) Make the final change-over of locks and transmit keys to the Owner and advise Owner's personnel of change-over in security provisions.
 - (8) Complete start-up testing of systems and instructions of Owner's operating-maintenance personnel. Discontinue or change over and remove from the project site, temporary facilities and services, along with construction tools and facilities, mock-ups and similar elements.
 - b. Inspection Procedures: Upon receipt of the Contractor's request, the Engineer will proceed with inspection or advise the Contractor of prerequisites not fulfilled. Following initial inspection, the Engineer will prepare a Certificate of Substantial Completion or advise the Contractor of the work which must be performed prior to issuance of the Certificate and will perform a repeat inspection when requested and assured by the Contractor that the work has been substantially completed. Results of the completed inspection will form the initial "punchlist" for final acceptance.
9. Prerequisites to Final Acceptance
- a. Prior to requesting the Engineer's final inspection for certification of final acceptance as required by the General Provisions, the Contractor shall complete the following and list known exceptions in the request:
 - (1) Submit a certified copy of the Engineer's final punchlist of itemized work to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, endorsed and dated by the Engineer.

- (2) Submit final meter readings for utilities, measured record of stored fuel, and similar data as of time of substantial completion or when the Owner took possession of and responsibility for corresponding elements of the work.
 - (3) Complete final cleaning up requirements, including touch-up of marred surfaces.
 - (4) Touch up and otherwise repair and restore marred exposed finishes.
- b. Re-inspection Procedures: Following Substantial Completion, the Contractor shall correct or remedy all Punchlist items to the satisfaction of the Engineer and Owner within a two (2) week period after the Date of Substantial Completion. If subsequent inspections are necessary after the two week period in order to eliminate all deficiencies, the cost of all subsequent inspections with respect to the Owner and Engineer's time shall be paid by the Contractor. When ready, the Contractor shall request in writing a final inspection of the work. Upon completion of re-inspection, the Engineer will prepare a Certificate of Final Acceptance or advise the Contractor of work not completed or obligations not fulfilled as required for Final Acceptance. If necessary, the procedures will be repeated.
10. Prerequisites to Final Payment
- a. Final Payment: Final Payment will be made after final acceptance of the project by the Engineer and Owner upon request by the Contractor on condition that the Contractor:
 - (1) Furnish properly executed complete releases of lien from all materialmen and subcontractors who have furnished materials or labor for the Work and submit supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
 - (2) Furnish the Contractor's Affidavit of Release of Liens (2 copies) that all materialmen and subcontractors have been paid in full. In the event they have not been paid in full, the Owner shall retain a sufficient sum to pay them in full and at his option may make direct payment as provided in Chapter 84, Florida Statutes, as amended, to obtain complete releases of lien.
 - (3) Furnish Contractor's Affidavit of Debts and Claims (2 copies).
 - (4) Furnish required sets of record drawings and maintenance and operating instructions of new mechanical equipment.
 - (5) Furnish guarantees signed by subcontractors, material suppliers, and countersigned by the Contractor for operating equipment.
 - (6) Submit specific warranties, workmanship-maintenance bonds, maintenance agreements, final certifications and similar documents.
 - (7) Furnish a signed guarantee, in form acceptable to the Engineer and Owner agreeing to repair or replace as decided by the Engineer, all work and materials that prove defective within one (1) year (or more) from the date of final acceptance, including restoration of all other work damaged in making such repairs or replacements.

- (8) Furnish Consent of Surety to final payment.
- (9) Submit updated final statement, accounting for final changes to Contract Sum.
- (10) Submit evidence of final, continuing insurance coverage complying with insurance requirements.
- (11) Certify that all Social Security, Unemployment and all other taxes (City, State, Federal Government) have been paid.
- (12) Provide receipt, as applicable, of affidavits certifying all labor standards of local, State, or Federal requirements have been complied with by the Contractor.
- (13) Submit actual DBE participation percentages.

11. Record Document Submittals

Specific requirements for record documents are shown in the section, PROJECT RECORD DOCUMENTS. Other requirements are indicated in the General Provisions. General submittal requirements are indicated in "Submittals" sections. Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for the Engineer's reference during normal working hours.

- a. Record Drawings: The Engineer shall organize record drawing sheets into manageable sets, bind with durable paper cover sheets and print suitable titles, dates and other identification on the cover of each set.
- b. Record Specifications: Upon completion of mark-ups, submit to the Engineer for the Owner's records.
- c. Record Product Data: Upon completion of mark-ups, submit complete sets to the Engineer for the Owner's records.
- d. Record Sample Submittal: Comply with the Engineer's instructions for packaging, identification, marking and delivery to the Owner's sample storage space.
- e. Miscellaneous Record Submittals: Complete miscellaneous records and place in good order, properly identified and bound or filed, ready for continued use and reference. Submit to the Engineer for the Owner's records.
- f. Maintenance Manuals: Complete, place in order, properly identify and submit to the Engineer for the Owner's records.

12. Closeout Procedures

General Operating and Maintenance Instructions: Arrange for each installer of work requiring continuing maintenance or operation, to meet with the Owner's personnel at the project site to provide basic instructions needed for proper operation and maintenance of the entire work. Include instructions by manufacturer's representatives where installers are not expert in the required procedures. Review maintenance manuals, record documentation, tools, spare parts and materials, lubricants, fuel, identification system, control sequences, hazards, cleaning and similar

procedures and facilities. For operational equipment, demonstrate start-up, shut-down, emergency operations, noise and vibration adjustments, safety, economy, efficiency adjustments, and similar operations. Review maintenance and operations in relation with applicable warranties, agreements to maintain bonds, and similar continuing commitments.

V. Final Cleaning

1. Provide final cleaning of the work, at the time indicated, consisting of cleaning each surface or unit of work to normal "clean" condition in a manner acceptable to the Engineer and Owner.
2. Removal of Protection: Remove temporary protection devices and facilities which were installed during the course of the work to protect previous completed work during the remainder of the construction period.
3. Compliances: Comply with safety standards and governing regulations for cleaning operations. Do not burn waste materials at site, bury debris or excess materials on the Owner's property. Do not discharge volatile or other harmful or dangerous materials into drainage systems. Remove waste materials from site and dispose of in a lawful manner.

Where extra materials of value remaining after the completion of the associated work have become the Owner's property, dispose of these as directed by the Owner.

END OF SP-2

SPECIAL PROVISION NO. 3
STAGING AND PHASING PROVISIONS FOR CONTRACTOR OPERATIONS

The Contractor shall prepare a written plan for his staging and phasing procedures in conformance with the Contract Drawings for all work. It shall be understood that the outline requirements presented are the minimum requirements. The Contractor is expected to provide added detailing as appropriate to fully inform the Project Manager of his/her intended method of operations and his/her schedules for proposed work.

The Engineer reserves the right to make changes to this plan to facilitate changes to the airport operations, which are in the best interest of the airport.

All costs associated with preparing the storage and staging area site shall be borne by the Contractor. This includes, but is not limited to, clearing and grading of the site, desired stabilization of the work yard surface, construction of any temporary utilities, access roads, all security fencing, etc.

END OF SP-3

SPECIAL PROVISION NO. 4

TIME OF COMPLETION AND LIQUIDATED DAMAGES

A. General

This project consists of several project elements, which are defined throughout the contract documents. The specific details pertaining to contract sequence and time are an important aspect of the project for planning of the various operational requirements of the airport. The Contractor shall be required to comply with the general intent of the phasing, scheduling and duration of the project as outlined in the contract documents or as otherwise approved by submittals allowed by the documents.

B. Construction Time

1. The construction plans and specifications set forth the time allocated to each of the elements of work required as part of this contract. The work shall be completed within the times established or as otherwise approved or liquidated damages in the amounts specified hereafter shall be assessed.
2. The Contractor must request and receive written approval from the Project Manager for acceptance of the work included in each of the phases or work prior to satisfying the requirements of being "complete."
3. The specified times for each of the project phases shall be outlined in these specifications or as otherwise agreed to in writing among the Owner, Project Manager and Contractor based upon the actual contract work awarded.

Substantial Completion contract time = **330 Calendar Days** (This is a calendar day contract);

Total contract time = **360 Calendar Days**

C. Construction Schedule

1. The Contractor shall prepare and submit a detailed schedule for his operations within the general limits and phasing restrictions included in the contract documents. This schedule shall be based upon the actual work ultimately awarded. This schedule shall be reviewed with the County, Project Manager and Contractor in order to establish the final approved schedule as it relates to this Special Provision.

D. Liquidated Damages

1. For this project, the rates for liquidated damages shall be Five Hundred and 00/100 dollars (\$500.00) per calendar day.

END OF SP-4

SPECIAL PROVISION NO. 5

MISCELLANEOUS FEDERAL AND STATE CONTRACT PROVISIONS

1.0 AGREEMENTS WITH THE UNITED STATES AND STATE OF FLORIDA

This Contract shall be subject to all restrictions of record affecting the Airport and the use thereof, all Federal and state laws and regulations affecting the same, and shall be subject and subordinate to the provisions of any existing agreement between the Owner and the United States of America or the State of Florida, their boards, members, agencies or commissions and to future agreements between the foregoing relative to the operation or maintenance of the Airport, the execution of which may be required as a condition precedent to the expenditure of Federal or state funds for the development of the Airport, or as a condition precedent to the use of the Airport, or any part thereof, by the Contractor, the Owner or otherwise. All provisions hereof shall be subordinate to the right of the United States of America to terminate the right of the Contractor, the Owner, or others, to occupy or to use the Airport, or any part thereof, during the time of war or national emergency.

2.0 COVENANTS AGAINST DISCRIMINATION

The Contractor, for itself, its successors in interest and assigns, as part of the consideration hereof, does hereby covenant and agree as a covenant running with the land that (1) no person on the grounds of race, color, religion, sex, age, physical handicap or national origin shall be excluded from participation in, denied the benefit of, or be otherwise subjected to discrimination in the use of the Airport under the provisions of this Agreement; (2) that in the construction of any improvements on, over or under the Airport and the furnishing of services thereon, no person shall be excluded from participation in, denied the benefits of, or otherwise be subjected to discrimination on the above-stated grounds; (3) that the Contractor shall use the Airport property in compliance with all other requirements imposed by or pursuant to state law or Title 49, Code of Federal Regulations, Department of Transportation - effectuation of Title VI of the Civil Rights Act of 1964, and as said Regulations may be amended. Should the Contractor authorize another person, with the Owner's prior written consent, to provide services or benefits upon the Airport property, the Contractor shall obtain from such person a written agreement pursuant to which such person shall, with respect to the services or benefits which it is authorized to provide, undertake for itself the obligations contained in this Subparagraph. The Contractor shall furnish the original of such Agreement to the Owner.

In the event of breach of any of the above non-discrimination covenants, the Owner shall have the right to terminate this Agreement. The right granted to the Owner by the foregoing sentence shall not be effective until the procedures of Title 49, Code of Federal Regulations, Part 21, if applicable, are followed and completed, including exercise or expiration of appeal rights.

The Owner may from time to time be required by the United States Government, its agencies, or the State of Florida to adopt additional or amended provisions including non-discrimination provisions, concerning the use and operation of the Airport, and the Contractor agrees that it will adopt any such requirement as a part of this Agreement.

If the Contractor shall furnish any services to the public at the Airport, it shall furnish said services on a fair, equal and not unjustly discriminatory basis to all users thereof and shall charge fair, reasonable and not unjustly discriminatory prices for each unit of service, provided that the Contractor shall be allowed to make reasonable and non-discriminatory discounts or rebates or other similar types of price reductions to volume purchasers, if any.

3.0 FAA APPROVAL REQUIRED

- 3.1 This Contract is subject to approval by the FAA. The Owner shall use its best efforts to obtain FAA approval. If the FAA requires any modifications to the Contract Documents as a condition of granting approval, and the Contractor fails to consent to the required modifications, then the Contract shall be void and the Owner shall have no liability to the Contractor.
- 3.2 If after initial approval by the FAA has been obtained, the FAA or its successor requires any modifications in this Contract as a condition of granting funds for the improvement of the Airport, the Contractor hereby consents to those modifications, which shall be accomplished in accordance with the General Provisions, Section 40-02, Alteration of Work and Quantities.

4.0 FEDERAL AND STATE AID PARTICIPATION

- 4.1 For AIP (Federal Aid) contracts, the United States Government has agreed to reimburse the Owner for some portion of the contract costs. Such reimbursement is made from time to time upon the Owner's request to the FAA. In consideration of the United States Government's (FAA's) agreement with the Owner, the Owner has included provisions in this Contract pursuant to the requirements of the Airport and Airway Improvement Act of 1982 (96 Stat. 671), as amended, and the Rules and Regulations of the FAA that pertain to the Work.
- 4.2 As required by the Act, the Work is subject to inspection and approval of duly authorized representatives of the Administrator of the FAA and is further subject to those provisions of the rules and regulations that are cited in the Contract Documents.
- 4.3 No requirements of the Act, the rules and regulations implementing the Act, or this Contract shall be construed as making the Federal Government a party to the Contract nor will any such requirement interfere, in any way, with the rights of either party to the Contract.

5.0 INSPECTION BY OTHERS

Pursuant to a Joint Participation Agreement between the State of Florida Department of Transportation and the Owner, the State of Florida may pay a portion of the costs of this improvement. The construction work and labor shall be done in accordance with the laws affecting and regulations of the State of Florida Department of Transportation. The construction work and materials, therefore, will be subject to inspection by the State of Florida Department of Transportation or its agents as it or they may deem necessary; provided, however, that such inspections shall not be construed so as to make the State of Florida Department of Transportation a party to this Contract and shall not interfere with the performance of the obligations of any party to this Contract.

6.0 ENVIRONMENTAL PROTECTION

- 6.1 For all construction contracts and subcontracts exceeding One Hundred Thousand Dollars (\$100,000.00) where Federal Aid is involved, the Contractor and its subcontractors represent and covenant that:
- 6.1.1 Any facility to be used in the performance of the Contract or to benefit from the Contract is not listed on the Environmental Protection Agency (EPA) List of Violating Facilities.
- 6.1.2 They comply and will comply with all requirements of Section 306 of the Clean Air Act (42 USC 1857(h)), Section 508 of the Clean Water Act (33 USC 1368), Executive Order 11738, environmental protection regulations (40 CFR Part 15) and all regulations issued thereunder.

6.1.3 As a condition for award of a contract, it will notify the awarding official of the receipt of any communication from the EPA indicating that a facility to be utilized for performance of or benefit from the contract is under consideration to be listed on the EPA List of Violating Facilities.

6.1.4 They will include or cause to be included in any contract or subcontract which exceeds One Hundred Thousand Dollars (\$100,000.00) the aforementioned criteria and requirements.

7.0 ARCHAEOLOGICAL AND HISTORICAL FINDINGS

Unless otherwise specified in the Contract Documents, the Contractor is advised that the site of the work is not within any property, district or site, and does not contain any building, structure or object listed in the current National Register of Historic Places published by the United States Department of the Interior.

Should the Contractor encounter, during its operations, any building, part of a building, structure, or object which is incongruous with its surroundings, the Contractor shall immediately cease operations in that location and notify the Engineer. The Engineer will investigate the Contractor's finding and will direct the Contractor to either resume or suspend operations.

8.0 RESTRICTIONS ON USE OF FOREIGN FIRMS AND PRODUCTS

8.1 The Contractor or Subcontractor, by submission of an offer and/or execution of a contract, certifies that it:

8.1.1 is not owned or controlled by one or more citizens or nationals of a foreign country included in the list of countries that discriminate against U.S. firms published by the Office of the United States Trade Representative (USTR);

8.1.2 has not knowingly entered into any contract or subcontract for this project with a contractor that is a citizen or national of a foreign country on said list, or is owned or is controlled directly or indirectly by one or more citizens or nationals of a foreign country on said list;

8.1.3 has not procured any product nor subcontracted for the supply of any product for use on the project that is produced in a foreign country on said list.

8.2 Unless the restrictions of this clause are waived by the Secretary of Transportation in accordance with 49 CFR 30.17, no contract shall be awarded to a contractor or subcontractor who is unable to certify to the above. If the contractor knowingly procures or subcontracts for the supply of any product or service of a foreign country on the said list for use on the project, the Federal Aviation Administration may direct, through the sponsor, cancellation of the contract at no cost to the Government.

8.3 Further, the Contractor agrees that, if awarded a contract resulting from this solicitation, it will incorporate this provision for certification without modification in each contract and in all lower tier subcontracts. The Contractor may rely upon the certification of a prospective subcontractor unless it has knowledge that the certification is erroneous.

8.4 The Contractor shall provide immediate written notice to the sponsor if the Contractor learns that its certification or that of a Subcontractor was erroneous when submitted or has become erroneous by reason of changed circumstances. The Subcontractor agrees to provide immediate written notice to the Contractor, if at any time it learns that its certification was erroneous by reason of changed circumstances.

8.5 This certification is a material representation of fact upon which reliance was placed when making the award. If it is later determined that the contractor or subcontractor knowingly rendered an erroneous certification, the Federal Aviation Administration may direct, through the sponsor, cancellation of the contract or subcontract for default at no cost to the Government.

8.6 Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render, in good faith, the certification required by this provision. The knowledge and information of a contractor is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

8.7 This certification concerns a matter within the jurisdiction of an agency of the United States of America and the making of a false, fictitious, or fraudulent certification may render the maker subject to prosecution under Title 18, United States Code, Section 1001.

8.8 The following countries are listed by the Office of the United States Trade Representative as countries which discriminate against U.S. firms: None

9.0 CERTIFICATION REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION

The Contractor certifies, by acceptance and execution of this contract, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible or voluntarily excluded from participation in this transaction by any Federal department or agency. It further agrees by executing and accepting this contract that it will include this clause without modification in all lower tier transactions, solicitations, proposals, contracts and subcontracts. Where the contractor or any lower tier participants is unable to certify to this statement, it shall provide the Owner with an explanation prior to the execution of this contract or the contractor's contracts and subcontracts with lower tier participants.

10.0 BUY AMERICAN REQUIREMENTS: STEEL & MANUFACTURED PRODUCTS

10.1 The Contractor agrees that only domestic steel and manufactured products will be used by the Contractor, Subcontractors, materialmen and Suppliers in the performance of this Contract, as defined in Paragraph 10.2 below:

10.2 The following terms apply to this clause:

1. Steel and manufactured products. As used in this clause, steel and manufactured products include (1) those produced in the United States or (2) a manufactured product produced in the United States, if the cost of its components mined, produced or manufactured in the United States exceeds 60 percent of the cost of all its components and final assembly has taken place in the United States.
2. Components. As used in this clause, "components" means those articles, materials and supplies incorporated directly into the steel and manufactured products.
3. Cost of Components. This means the cost for production of the components, exclusive of final assembly costs.

END OF SPECIAL PROVISION NO. 5

SPECIAL PROVISION NO. 6

E-VERIFY REQUIREMENTS

The Contractor and all sub-contractors shall be in compliance with Florida State Executive Order Number 11-02. The Contractor shall provide a certification to the Owner stating that they are in compliance with this order.

END OF SPECIAL PROVISION NO. 6

TECHNICAL SPECIFICATIONS

**BID DOCUMENTS
HANGAR DEVELOPMENTS
MARIANNA MUNICIPAL AIRPORT, MARIANNA, FLORIDA**

**SECTION 101
MOBILIZATION**

PART 1 - DESCRIPTION

101-1.1 GENERAL. The work specified in this item consists of preparatory work and operations to mobilize for beginning work on the project. Mobilization shall include, but not be limited, to those operations necessary for the movement of personnel, equipment, supplies and incidentals to the project site, and for the establishment of temporary offices, buildings, utilities, safety equipment and first aid supplies, sanitary and other facilities, as required by these specifications and State and local laws and regulations. This Section also includes all preparatory work, operations to maintain aircraft and vehicular traffic, compliance with safety provisions, compliance with airport security and badging requirements, and field identification of airport property boundary. The costs of bonds and any required insurance, permitting, and any other preconstruction expense necessary for the start of the work, excluding the cost of construction materials, shall also be incidental to this Section.

101-1.2 DEMOBILIZATION. Upon or before issuance of substantial completion, the Contractor shall promptly begin to demobilize men, equipment, and facilities from the project site. At the time of final completion all materials, equipment, offices and temporary facilities shall be removed from the site. All staging areas, storage areas, and access routes shall be fully restored to their previous conditions or as otherwise approved by the Engineer. Final payment as well as all retainage may be withheld until the site restoration and demobilization are complete.

PART 2 - BASIS OF PAYMENT

101-2.1 GENERAL. The work and incidental costs covered under this item shall be paid for at the contract lump sum price for Mobilization.

101-2.2 PARTIAL PAYMENTS. Partial payments will be made in accordance with the following:

<u>Percent of Original Contract Amount Earned</u>	<u>Allowable Percent of the Lump Sum Price for the Item*</u>
5	25
10	50
25	75
50	100

* The Lump Sum amount to be paid for under this item is limited to ten (10%) percent of the original Contract amount. Any amount bid in excess of ten (10%) percent will be paid upon completion of all work on the contract. The standard retainage, as specified in the General Conditions, shall be applied to this item.

Payment shall be made under:

Pay Item 101-1 Mobilization -- Lump Sum (LS)

END OF ITEM 101

**SECTION 102
MAINTENANCE OF TRAFFIC**

102-1 Description.

Maintain traffic within the limits of the project for the duration of the construction period, including any temporary suspensions of the work. Construct and maintain detours. Provide facilities for access to residences, businesses, etc., along the project. Furnish, install and maintain traffic control and safety devices during construction. Furnish and install work zone pavement markings for maintenance of traffic in construction areas. Provide any other special requirements for safe and expeditious movement of traffic specified on the plans. Maintenance of Traffic includes all facilities, devices and operations as required for safety and convenience of the public within the work zone.

Do not maintain traffic over those portions of the project where no work is to be accomplished or where construction operations will not affect existing roads. Do not obstruct or create a hazard to any traffic during the performance of the work, and repair any damage to existing pavement open to traffic.

Include the cost of any work that is necessary to meet the requirements of the Contract Documents under the MOT pay item, when there is not a pay item provided.

102-2 Materials.

Meet the following requirements:

Bituminous Adhesive	Section 970
Temporary Retroreflective Pavement Markers.....	Section 990
Paint	Section 971
Removable Tape	Section 990
Glass Spheres	Section 971
Temporary Traffic Control Device Materials	Section 990
Retroreflective and Nonreflective Sheeting for Temporary Traffic Control Devices	Section 994

102-2.1 Temporary Traffic Control Devices: Use only the materials meeting the requirements of Section 990, Section 994, Design Standards and the MUTCD.

102-2.2 Detour: Provide all materials for the construction and maintenance of all detours.

102-2.3 Commercial Materials for Driveway Maintenance: Provide materials of the type typically used for base, including recycled asphalt pavement material, and having stability and drainage properties that will provide a firm surface under wet conditions.

102-3 Specific Requirements.

102-3.1 Beginning Date of Contractor's Responsibility: Maintain traffic starting the day work begins on the project or on the first day Contract time is charged, whichever is earlier.

102-3.2 Worksite Traffic Supervisor: Provide a Worksite Traffic Supervisor in accordance with Section 105. Provide the Worksite Traffic Supervisor with all equipment and materials needed to set up, take down, maintain traffic control, and handle traffic-related situations.

Ensure that the Worksite Traffic Supervisor performs the following duties:

1. Performs on site direction of all traffic control on the project.
2. Is on site during all set up and take down, and performs a drive through inspection immediately after set up.
3. Is on site during all nighttime operations to ensure proper Maintenance of Traffic.
4. Immediately corrects all safety deficiencies and does not permit minor deficiencies that are not immediate safety hazards to remain uncorrected for more than 24 hours.
5. Is available on a 24-hour per day basis and present within 45 minutes after notification of an emergency situation and is prepared to positively respond to repair the work zone traffic control or to provide alternate traffic arrangements.
6. Conducts daily daytime and weekly nighttime inspections of projects with predominately daytime work activities, and daily nighttime and weekly daytime inspections of projects with predominantly nighttime work activities of all traffic control devices, traffic flow, pedestrian, bicyclist, and business accommodations.

Advise the project personnel of the schedule of these inspections and give them the opportunity to join in the inspection as is deemed necessary. Submit a comprehensive weekly report, using the Department's currently approved form, to the Engineer detailing the condition of all traffic control devices (including pavement markings) being used. Include assurances in the inspection report that pedestrians are accommodated with a safe travel path around work sites and safely separated from mainline traffic, that existing or detoured bicyclist paths are being maintained satisfactorily throughout the project limits, and that existing businesses in work areas are being provided with adequate entrances for vehicular and pedestrian traffic during business hours. Have the Worksite Traffic Supervisor sign the report and certify that all of the above issues are being handled in accordance with the Contract Documents. When deficiencies are found, the Worksite Traffic Supervisor is to note such deficiencies and include the proposed corrective actions, including the date corrected.

The Department may disqualify and remove from the project a Worksite Traffic Supervisor who fails to comply with the provisions of this Section. The Department may temporarily suspend all activities, except traffic, erosion control and such other activities that are necessary for project maintenance and safety, for failure to comply with these provisions.

102-4 Alternative Traffic Control Plan.

The Contractor may propose an alternative Traffic Control Plan (TCP) to the plan presented in the Contract Documents. Have the Contractor's Engineer of Record sign and seal the alternative plan. Prepare the TCP in conformance with and in the form outlined in the current version of the Roadway Plans Preparation Manual. Indicate in the plan a TCP for each phase of activities. Take responsibility for identifying and assessing any potential impacts to a utility that may be caused by the alternate TCP proposed by the Contractor, and notify the Department in writing of any such potential impacts to utilities.

Engineer's approval of the alternate TCP does not relieve the Contractor of sole responsibility for all utility impacts, costs, delays or damages, whether direct or indirect, resulting from Contractor initiated changes in the design or construction activities from those in the original Contract Specifications, design plans (including traffic control plans) or other Contract Documents and which effect a change in utility work different from that shown in the utility plans, joint project agreements or utility relocation schedules.

The Department reserves the right to reject any Alternative Traffic Control Plan. Obtain the Engineer's written approval before beginning work using an alternate TCP. The Engineer's written approval is required for all modifications to the TCP. The Engineer will only allow changes to the TCP in an emergency without the proper documentation.

102-5 Traffic Control.

102-5.1 Standards: FDOT Design Standards (DS) are the minimum standards for the use in the development of all traffic control plans. The MUTCD Part VI is the minimum national standard for traffic control for highway construction, maintenance, and utility operations. Follow the basic principles and minimum standards contained in these documents for the design, application, installation, maintenance, and removal of all traffic control devices, warning devices and barriers which are necessary to protect the public and workers from hazards within the project limits.

102-5.2 Maintenance of Roadway Surfaces: Maintain all lanes that are being used for the maintenance of traffic, including those on detours and temporary facilities, under all weather conditions. Keep the lanes reasonably free of dust, potholes and rutting. Provide the lanes with the drainage facilities necessary to maintain a smooth riding surface under all weather conditions.

102-5.3 Number of Traffic Lanes: Maintain one lane of traffic in each direction. Maintain two lanes of traffic in each direction at existing four (or more) lane cross roads, where necessary to avoid undue traffic congestion. Construct each lane used for maintenance of traffic at least as wide as the traffic lanes existing in the area before commencement of construction. Do not allow traffic control and warning devices to encroach on lanes used for maintenance of traffic.

The Engineer may allow the Contractor to restrict traffic to one-way operation for short periods of time provided that the Contractor employs adequate means of traffic control and does not unreasonably delay traffic. When a construction activity requires restricting traffic to one-way operations, locate the flaggers within view of each other when possible. When visual contact between flaggers is not possible, equip them with 2-way radios, official, or pilot vehicle(s), or use traffic signals.

102-5.4 Crossings and Intersections: Provide and maintain adequate accommodations for intersecting and crossing traffic. Do not block or unduly restrict any road or street crossing the project unless approved by the Engineer. Maintain all existing actuated or traffic responsive mode signal operations for main and side street movements for the duration of the Contract. Restore any loss of detection within 12 hours. Use only detection technology listed on the Department's Approved Products List (APL) and approved by the Engineer to restore detection capabilities.

Before beginning any construction, provide the Engineer a plan for maintaining detection devices for each intersection and the name(s) and phone numbers of persons that can be contacted when signal operation malfunctions.

102-5.5 Access for Residences and Businesses: Provide continuous access to all residences and all places of business.

102-5.6 Protection of the Work from Injury by Traffic: Where traffic would be injurious to a base, surface course, or structure constructed as a part of the work, maintain all traffic outside the limits of such areas until the potential for injury no longer exists.

102-5.7 Flagger: Provide trained flaggers in accordance with Section 105.

102-5.8 Conflicting Pavement Markings: Where the lane use or where normal vehicle or pedestrian paths are altered during construction, remove all pavement markings (paint, tape, thermoplastic, raised pavement markers, etc.) that will conflict with the adjusted vehicle or pedestrian paths. Use of paint to cover conflicting pavement markings is prohibited. Remove conflicting pavement markings using a method that will not damage the surface texture of the pavement and which will eliminate the previous marking pattern regardless of weather and light conditions.

Remove all pavement markings that will be in conflict with “next phase of operation” vehicle pedestrian paths as described above, before opening to vehicle traffic or use by pedestrians.

Cost for removing conflicting pavement markings (paint, tape, thermoplastic, raised pavement markers, etc.) to be included in Maintenance of Traffic, Lump Sum.

102-5.9 Vehicle and Equipment Visibility: Equip all pickups and automobiles used on the project with a minimum of one Class 2 amber or white warning light that meets the Society of Automotive Engineers Recommended Practice SAE J595, dated November 1, 2008, or SAE J845, dated December 1, 2007, and incorporated herein by reference. Existing lights that meet SAE J845, dated March, 1992, or SAE J1318, dated April, 1986, may be used to its end of service life. Lights should be unobstructed by ancillary vehicle equipment such as ladders, racks or booms. If the light is obstructed, additional lights will be required. The lights shall be operating when a vehicle is in a work area where a potential hazard exists, when operating the vehicle at less than the average speed for the facility while performing work activities, making frequent stops or called for in the plans or Design Standards.

Equip all other vehicles and equipment with a minimum of 4 square feet of retroreflective sheeting or flashing lights.

To avoid distraction to motorists, do not operate the lights on the vehicles or equipment when the vehicles are outside the clear zone or behind a barrier.

102-5.10 No Waiver of Liability: Conduct operations in such a manner that no undue hazard results due to the requirements of this Article. The procedures and policies described herein in no way acts as a waiver of any terms of the liability of the Contractor or his surety.

102-6 Detours.

102-6.1 General: Construct and maintain detour facilities wherever it becomes necessary to divert traffic from any existing roadway or bridge, or wherever construction operations block the flow of traffic.

102-6.2 Construction: Plan, construct, and maintain detours for the safe passage of traffic in all conditions of weather. Provide the detour with all facilities necessary to meet this requirement.

Where the plans call for the Department to furnish detour bridge components, construct the pile bents in accordance with the plans, unless otherwise authorized by the Engineer.

Submit a letter with the following: company name, phone number, office address, project contact person, project number, detour bridge type, bridge length, span length, location and usage time frames, to the Engineer at least 30 calendar days before the intended pick-up date, to obtain the storage facility location and list of components for the project. Upon receipt of letter, the Engineer will, within ten calendar days provide an approved material list to the Contractor and the appropriate Department storage yard.

Provide a letter with an original company seal, identifying the representative with authority to pick up components, to the Engineer at least ten calendar days before the proposed pick-up date. The Department is not obligated to load the bridge components without this notice. Take responsibility and sign for each item loaded at the time of issuance.

Provide timber dunnage, and transport the bridge components from the designated storage facility to the job site. Unload, erect, and maintain the bridge, then dismantle the bridge and load and return the components to the designated storage facility.

Notify the Engineer in writing at least ten calendar days before returning the components. Include in this notice the name of the Contractor's representative authorized to sign for return of the bridge components. The yard supervisor is not obligated to unload the bridge components without this notice.

The Department will provide equipment and an operator at the Department's storage facility to assist in loading and unloading the bridge components. Furnish all other labor and equipment required for loading and unloading the components.

The Department's representative will record all bridge components issued or returned on the Detour Bridge Issue and Credit Ticket. The Tickets must be signed by a Department and Contractor representative, after loading or unloading each truck to document the quantity and type of bridging issued or returned.

Bind together all bridge components to be returned in accordance with the instructions given by the storage facility. The yard supervisor will repack components that are not packed in compliance with these instructions. Upon request, written packing instructions will be made available to the Contractor, before dismantling of the bridge for return to the Department's storage facility.

Assume responsibility for any shortage or damage to the bridge components. Monies due the Contractor will be reduced at the rate of \$35.00 per hour plus materials for repacking, repairs or replacement of bridge components.

The skid resistance of open steel grid decking on the detour bridge may decrease gradually after opening the bridge to traffic. The Department will furnish a pneumatic floor scabber machine for roughening the roadway surface of the detour bridge decking. Provide an air compressor at the job site

with 200 ft³/minute capacity, 90 psi air pressure for the power supply of the machine, and an operator. Transport the scabber machine to and from the Department's Structures Shop. Repair any damage to the scabber machine caused by operations at no expense to the Department. Perform scabbling when determined necessary by the Engineer. The Department will pay for the cost of scabbling as Unforeseeable Work in accordance with 4-4.

Return the bridge components to the designated storage facility beginning no later than ten calendar days after the date the detour bridge is no longer needed, the date the new bridge is placed in service, or the date Contract Time expires, whichever is earliest. Return the detour bridging at an average of not less than 200 feet per week. Upon failure to return the bridge components to the Department within the time specified, compensate the Department for the bridge components not returned at the rate of \$5.00 per 10 feet, per day, per bridge, for single lane; and \$10.00 per 10 feet, per day, per bridge, for dual lane until the bridge components are returned to the Department.

102-6.3 Construction Methods: Select and use construction methods and materials that provide a stable and safe detour facility. Construct the detour facility to have sufficient durability to remain in good condition, supplemented by maintenance, for the entire period that the detour is required.

102-6.4 Removal of Detours: Remove detours when they are no longer needed and before the Contract is completed. Take ownership of all materials from the detour and dispose of them, except for materials, which might be on loan from the Department with the stipulation that they are returned.

102-6.5 Detours Over Existing Roads and Streets: When the Department specifies that traffic be detoured over roads or streets outside the project area, do not maintain such roads or streets. However, maintain all signs and other devices placed for the purpose of the detour.

102-6.6 Operation of Existing Movable Bridges: The Department will maintain and operate existing moveable bridges that are to be removed by the Contractor until such time as they are closed to traffic. During this period, make immediate repairs of any damage to such structures caused by use or operations related to the work at no expense to the Department, but do not provide routine repairs or maintenance. In the event that use or operations result in damage to a bridge requiring repairs, give such repairs top priority to any equipment, material, or labor available.

102-7 Traffic Control Officer.

Provide uniformed law enforcement officers, including marked law enforcement vehicles, to assist in controlling and directing traffic in the work zone when the following types of work is necessary on projects:

1. Traffic control in a signalized intersection when signals are not in use.
2. When Standard Index No. 619 is used on Interstate at nighttime and called for in the plans.
3. When Standard Index No. 655 Traffic Pacing for overhead work is called for in the plans or approved by the Engineer.
4. When pulling conductor/cable above an open traffic lane on limited access facilities, when called for in the plans or approved by the Engineer.

102-8 Driveway Maintenance.

102-8.1 General: Ensure that each residence and or business has safe, stable, and reasonable access.

102-8.2 Construction Methods: Place, level, manipulate, compact, and maintain the material, to the extent appropriate for the intended use.

As permanent driveway construction is accomplished at a particular location, the Contractor may salvage and reuse previously placed materials that are suitable for reuse on other driveways.

102-9 Temporary Traffic Control Devices.

102-9.1 Installation and Maintenance: Install and maintain temporary traffic control devices as detailed in the plans, Index 600 of the Design Standards and when applicable, in accordance with the approved vendor drawings, as provided on the Qualified Products List (QPL) or the Approved Products List (APL). Erect the required temporary traffic control devices to prevent any hazardous conditions and in conjunction with any necessary traffic re-routing to protect the traveling public, workers, and to safeguard the work area. Use only those devices that are on the QPL or the APL. Immediately remove or cover any devices that do not apply to existing conditions.

All temporary traffic control devices must meet the requirements of National Cooperative Highway Research Program Report 350 (NCHRP 350) or the Manual for Assessing Safety Hardware 2009 (MASH) and current FHWA directives. Manufacturers seeking evaluation must furnish certified test reports showing that their product meets all test requirements set forth by NCHRP 350 or the MASH. Manufacturers seeking evaluation of Category I devices for inclusion on the QPL shall include the manufacturer's self-certification letter. Manufacturer's seeking evaluation of Category II and Category III devices for inclusion on the QPL shall include the FHWA WZ numbered acceptance letter with attachments and vendor drawings of the device in sufficient detail to enable the Engineer to distinguish between this and similar devices. For devices requiring field assembly or special site preparation, vendor drawings shall include all field assembly details and technical information necessary for proper application and installation and must be signed and sealed by a Professional Engineer registered in the State of Florida. Manufacturers seeking evaluation of Category IV devices for inclusion on the QPL or APL must comply with the requirements of Section 990 and include detailed vendor drawings of the device along with technical information necessary for proper application, field assembly and installation.

Ensure that the QPL or APL number is permanently marked on the device at a readily visible location. Sheeting used on devices is exempt from this marking requirement.

Notify the Engineer of any scheduled operation which will affect traffic patterns or safety sufficiently in advance of commencing such operation to permit his review of the plan for the proposed installation of temporary traffic control devices.

Ensure an employee is assigned the responsibility of maintaining the position and condition of all temporary traffic control devices throughout the duration of the Contract. Keep the Engineer advised at all times of the identification and means of contacting this employee on a 24-hour basis.

Keep temporary traffic control devices in the correct position, properly directed, clearly visible and clean, at all times. Ensure that all traffic control devices meet acceptable standards as outlined in

American Traffic Safety Services Association (ATSSA's) "Quality Guidelines for Temporary Traffic Control Devices and Features". Immediately repair, replace or clean damaged, defaced or dirty devices.

102-9.2 Work Zone Signs: Provide signs in accordance with the plans and Design Standards. Meet the requirements of 700-2.5 and 990-8. Use only approved systems, which includes sign support posts or stands and attachment hardware (nuts, bolts, clamps, brackets, braces, etc.), meeting the vendor requirements specified on the QPL Drawings.

Attach the sign to the sign support using hardware meeting the manufacturer's recommendations and as specified in the Design Standards.

Provide Federal Highway Administration's (FHWA) accepted sign substrate for use with accepted sign stands on the National Highway System (NHS) under the provisions of the National Cooperative Highway Research Program (NCHRP) Report 350 "Recommended Procedures for the Safety Performance Evaluation of Highway Features."

102-9.3 Business Signs: Provide and place signs in accordance with the plans and Design Standards. Furnish signs having retroreflective sheeting meeting the requirements of Section 990.

Use signs with specific business names on each sign. Install logos provided by business owners and approved by the Engineer. Standard Business entrance signs meeting the requirements of Index 17355 without specific business names may be used only with the approval of the Engineer.

102-9.4 High Intensity Flashing Lights: Furnish Type B lights in accordance with the plans and Design Standards.

102-9.5 Warning/Channelizing Devices: Furnish warning/channelizing devices in accordance with the plans and Design Standards.

102-9.5.1 Retroreflective Collars for Traffic Cones: Use collars for traffic cones listed on the QPL that meet the requirements of Section 990. Use cone collars at night designed to properly fit the taper of the cone when installed. Place the upper 6 inch collar a uniform 3 1/2 inch distance from the top of the cone and the lower 4 inch collar a uniform 2 inch distance below the bottom of the upper 6 inch collar. Ensure that the collars are capable of being removed for temporary use or attached permanently to the cone in accordance with the manufacturer's recommendations. Provide a white sheeting having a smooth outer surface and that has the property of a retroreflector over its entire surface.

102-9.5.2 Barrier Wall (Temporary): Furnish, install, maintain, remove and relocate a temporary barrier wall in accordance with the plans. Ensure that temporary concrete barrier wall for use on roadway sections, complies with Index No. 412, 415 or 414 as specified in the plans. Ensure that temporary concrete barrier wall for use on bridge and wall sections, complies with Index No 414 as specified in the plans. Ensure that temporary water filled barrier wall used on roadway sections meets the NCHRP Report 350 criteria or the MASH and is listed on the Qualified Products List (QPL). Barriers meeting the requirements of Index No. 412, 415 or temporary water filled barriers on the QPL will not be accepted as an alternate to barriers meeting the requirements of Index No. 414.

102-9.5.3 Glare Screen (Temporary): Use temporary glare screens listed on the QPL that meet the requirements of Section 990. Furnish, install, maintain, remove and relocate glare screen systems in conjunction with temporary barrier wall at locations identified in the plans.

Ensure the anchorage of the glare screen to the barrier is capable of safely resisting an equivalent tensile load of 600 lb/ft of glare screen, with a requirement to use a minimum of three fasteners per barrier section.

When glare screen is utilized on temporary barrier wall, warning lights will not be required.

102-9.6 Temporary Crash Cushion (Redirect/Inertia): Furnish, install, maintain and subsequently remove temporary crash cushions in accordance with the details and notes shown in the plans, the Design Standards, and requirements of the pre-approved alternatives listed on the QPL. Maintain the crash cushions until their authorized removal. Repair all attachment scars to permanent structures and pavements after crash cushion removal. Make necessary repairs due to defective material, work, or Contractor operations at no cost to the Department. Restore crash cushions damaged by the traveling public within 24 hours after notification as authorized by the Engineer.

102-9.7 Guardrail (Temporary): Furnish guardrail (temporary) in accordance with the plans and Design Standards. Meet the requirements of Section 536.

102-9.8 Advance Warning Arrow Panel: Furnish advance warning arrow panels that meet the requirements of Section 990 as required by the plans and Design Standards to advise approaching traffic of lane closures or shoulder work.

102-9.9 Portable Changeable Message Sign (PCMS): Furnish portable changeable message signs that meet the requirements of Section 990 as required by the plans and Design Standards to supplement other temporary traffic control devices used in work zones.

A truck mounted PCMS may be used as a stand alone maintenance of traffic device only when used for accident or incident management situations as defined in the MUTCD and is listed on the APL.

102-9.10 Portable Regulatory Signs (PRS): Furnish portable regulatory signs that meet the requirements of 990 as required by the plans and Design Standards.

Activate portable regulatory signs only during active work activities and deactivate when no work is being performed.

102-9.11 Radar Speed Display Unit (RSDU): Furnish radar speed display units that meet the requirements of Section 990 as required by the plans and Design Standards to inform motorists of the posted speed and their actual speed.

Activate the radar speed display unit only during active work activities and deactivate when no work is being performed.

102-9.12 Temporary Traffic Control Signals: Furnish, install and operate temporary traffic control signals as indicated in the plans. Temporary traffic control signals will consist of either portable or fixed traffic signals.

Provide portable traffic signals that meet the requirements of the Design Standards, 603-2 and are listed on the APL. The Engineer may approve used signal equipment if it is in acceptable condition.

102-9.13 Temporary Traffic Detection Technology: Furnish, install and operate Temporary Traffic Detection Technology listed on the Department's APL and approved by the Engineer to restore detection capabilities.

102-9.14 Truck Mounted Attenuators and Trailer Mounted Attenuators: Furnish, install and maintain only those attenuators that meet the requirements of NCHRP 350 or the MASH.

Use Truck Mounted Attenuators or Trailer Mounted Attenuators, when called for in the Design Standards. Use attenuators listed on the QPL.

When attenuators are called for, use either a truck mounted attenuator or a trailer mounted attenuator system designed and installed in accordance with the manufacturers recommendations.

Equip the attenuator cartridge with lights and reflectors in compliance with applicable Florida motor vehicle laws, including turn signals, dual tail lights, and brake lights. Ensure that lights are visible in both the raised and lowered positions if the unit is capable of being raised.

Ensure that the complete unit is painted DOT yellow (Fed. Std. 595 b, No. 13538). Stripe the rear facing of the cartridge in the operating position with the alternating 6 inch white and 6 inch safety orange 45 degree striping to form an inverted "V" at the center of the unit and slope down and toward the outside of the unit, in both directions from the center. In the raised position, place at least the same square footage of striping on the bottom of the cartridge as placed on the rear facing cartridge in the open position. Use Type III retroreflectorized sheeting for striping.

Attenuators will not be paid for separately. Include the cost of the truck with either a truck mounted attenuator or a trailer mounted attenuator in Maintenance of Traffic Lump Sum. Payment includes all costs, including furnishing, maintaining and removal when no longer required, and all materials, labor, tools, equipment and incidentals required for attenuator maintenance.

102-9.15 Temporary Raised Rumble Strip Sets: When called for in the plans, furnish, install, maintain, remove, and reinstall temporary raised rumble strip sets.

Install the temporary raised rumble strip sets per the manufacturer's recommendations and in accordance with Index 600.

The temporary raised rumble strip may be either a removable polymer striping tape or a molded engineered polymer material.

102-9.16 Automated Flagger Assistance Devices (AFAD): Furnish, install, maintain, remove and relocate AFADs in accordance with the plans and Design Standards. Position AFADs where they are clearly visible to oncoming traffic and out of the lane of traffic. The devices may be operated either by a single flagger at one end of the traffic control zone, from a central location, or by a separate flagger near each device's location.

AFADs may be either a remotely controlled Stop/Slow AFAD mounted on either a trailer or a movable cart system, or a remotely controlled Red/Yellow Lens AFAD.

AFADs will not be paid for separately. AFADs may be used as a supplement or an alternate to flaggers in accordance with Index 603. Include the cost for AFADs in Maintenance of Traffic Lump Sum.

102-10 Work Zone Pavement Marking.

102-10.1 Description: Furnish and install Work Zone Pavement Markings for maintenance of traffic in construction areas and in close conformity with the lines and details shown in the plans and Design Standards.

Centerlines, lane lines, edge lines, stop bars and turn arrows will be required in work zones prior to opening the road to traffic.

The most common types of Work Zone Pavement Markings are painted pavement markings and removable tape. Other types of Work Zone Pavement Markings may be identified in the plans.

102.10.2 Painted Pavement Markings:

102-10.2.1 General: Use painted pavement markings meeting the requirements of Section 710. Use standard waterborne paint unless otherwise identified in the plans or approved by the Engineer.

102-10.3 Removable Tape:

102-10.3.1 General: Use removable tape listed on the QPL and meeting the requirements of 990-4.

102-10.3.2 Application: Apply removable tape with a mechanical applicator to provide pavement lines that are neat, accurate and uniform. Equip the mechanical applicator with a film cut-off device and with measuring devices that automatically and accumulatively measure the length of each line placed within an accuracy tolerance of $\pm 2\%$. Ensure removable tape adheres to the road surface. Removable tape may be placed by hand on short sections 500 feet or less if it is done in a neat accurate manner.

102-10.3.3 Retroreflectivity: Apply white and yellow traffic stripes and markings that will attain an initial retroreflectivity of not less than 300 mcd/lx·m² for white and contrast markings and not less than 250 mcd/lx·m² for yellow markings. Black portions of contrast tapes and black masking tapes must be non-reflective and have a reflectance of less than 5 mcd/lx m². At the end of the six month service life, the retroreflectance of white and yellow removable tape shall not be less than 150 mcd/lx·m².

102-10.3.4 Removability: Provide removable tape capable of being removed from bituminous concrete and portland cement concrete pavement intact or in substantially large strips, either manually or by a mechanical roll-up device, at temperatures above 40°F, without the use of heat, solvents, grinding or blasting.

102-10.4 Temporary Retroreflective Pavement Markers (RPM's): Use markers listed on the QPL and meeting the requirements of 990-5. Apply all markers in accordance with the Design Standards, Index No. 600, prior to opening the road to traffic. Replace markers any time after installation when more than three consecutive markers fail or are missing, at no expense to the Department, in a timely manner, as directed by the Engineer.

102-11 Method of Measurement.

102-11.1 General: Devices installed/used on the project on any calendar day or portion thereof, within the allowable Contract Time, including time extensions which may be granted, will be paid for at the Contract unit price for the applicable pay item, except those paid for as Lump Sum.

102-11.2 Traffic Control Officers: The quantity to be paid for will be at the Contract unit price per hour (4 hour minimum) for the actual number of officers certified to be on the project site, including any law enforcement vehicle(s) and all other direct and indirect costs. Payment will be made only for those traffic control officers specified in the Plans and authorized by the Engineer.

102-11.3 Special Detours: When a detour facility is specifically detailed in the plans, or is otherwise described or detailed as a special item, and an item for separate payment is included in the proposal, the work of constructing, maintaining, and subsequently removing such detour facilities will be paid for separately. Traffic control devices, warning devices, barriers, signing, and pavement markings for Special Detours will also be paid for separately.

When the plans show more than one detour, each detour will be paid for separately, at the Contract lump sum price for each.

Where a separate item for a specific detour facility is included in the proposal, payment will be made under Special Detour.

102-11.4 Commercial Material for Driveway Maintenance: The quantity to be paid for will be the certified volume, in cubic yards, of all materials authorized by the Engineer, acceptably placed and maintained for driveway maintenance. The volume, which is authorized to be reused, and which is acceptably salvaged, placed, and maintained in other designated driveways will be included again for payment.

102-11.5 Work Zone Signs: The number of temporary post-mounted signs (Temporary Regulatory, Warning and Guide) certified as installed/used on the project will be paid for at the Contract unit price for Work Zone Signs. When multiple signs are located on single or multiple post(s), each sign panel will be paid individually. Signs greater than 20 ft² and detailed in the plans will be paid for under Lump Sum MOT.

Temporary portable signs (excluding Mesh signs) and Vehicular Mounted Signs will be included for payment under work zone signs, only if used in accordance with the Design Standards.

102-11.6. Business Signs: The number of business signs certified as installed/used on the project will be paid for at the Contract unit price for Business Signs.

102-11.7 High Intensity Flashing Lights: The number of high intensity flashing lights (Type B) certified as installed/used on the project will be paid for at the Contract unit price for High Intensity Flashing Lights (Temporary - Type B).

102-11.8 Channelizing Devices: The number of Type I, Type II, Direction Indicator Barricade, Type III, Vertical Panel and Drum Channelizing Devices certified as installed/used on the project meeting the requirements of Design Standards, Index No. 600 and have been properly maintained will be paid for at the Contract unit prices for Barricade (Temporary). Payment will be made for each channelizing device that is used to delineate trailer mounted devices. Payment will be made for channelizing devices delineating portable changeable message signs during the period beginning fourteen working days before Contract Time begins as authorized by the Engineer.

102-11.9 Barrier Wall (Temporary): The Contract unit price for Barrier Wall (Temporary) will be full compensation for furnishing, installing, maintaining, and removing the barrier wall. When called for, the Contract unit price for Barrier Wall (Temporary/Relocate) will be full compensation for relocating the barrier. The certified quantity to be paid for will be determined by the number of sections times the nominal length of each section.

102-11.10 Lights, Temporary, Barrier Wall Mount: The number of Type C Steady Burn lights, mounted on barrier wall, certified as installed/used on the project, meeting the requirements of the Design Standards and have been properly maintained will be paid for at the Contract unit price for Lights Temporary, Barrier Wall Mount.

102-11.11 Glare Screen (Temporary): The certified quantity to be paid for will be determined by the number of sections times the nominal length of each section.

102-11.12 Temporary Crash Cushions:

102-11.12.1 Redirective: The quantity to be paid for will be the number of Temporary Crash Cushions (Redirective) certified as installed/used and maintained on the project, including object marker.

102-11.12.2 Inertia: The quantity to be paid for will be the number of Temporary Crash Cushions (Inertia) complete arrays certified as installed/used and maintained in accordance with the plans and Design Standards, Index No. 417.

102-11.13 Temporary Guardrail: The quantity to be paid for will be the length, in feet, of temporary guardrail constructed and certified as installed/used on the project. The length of a run of guardrail will be determined as a multiple of the nominal panel lengths.

102-11.14 Advance Warning Arrow Panel: The quantity to be paid at the contract unit price will be for the number of advance warning arrow panels certified as installed/used on the project on any calendar day or portion thereof within the contract time.

102-11.15 Portable Changeable Message Sign: The quantity to be paid at the contract unit price will be for the number of portable changeable message signs certified as installed/used on the project on any calendar day or portion thereof within the contract time. Payment will be made for each portable

changeable message sign that is used during the period beginning fourteen working days before Contract Time begins as authorized by the Engineer.

102-11.16 Portable Regulatory Signs: The quantity to be paid for will be the number of portable regulatory signs certified as installed/used on the project on any calendar day or portion thereof within the contract time, will be paid for the contract unit price for portable regulatory sign.

102-11.17 Radar Speed Display Unit: The quantity to be paid for will be the number of radar speed display units certified as installed/used on the project on any calendar day or portion thereof within the contract time, will be paid for the contract unit price for radar speed display unit.

102-11.18 Temporary Traffic Control Signals: The quantity of Temporary Traffic Control Signals to be paid for will be the number of completed installations (each signalized location) of portable traffic signals, or the number of fixed traffic signals in place and operating on the project, as authorized by the Engineer and certified as in place and in operation on the project.

102-11.19 Temporary Traffic Detection Technology: The quantity of Temporary Traffic Detection Technology to be paid for will be the number of completed and accepted intersections utilizing Temporary Traffic Detection Technology, authorized by the Engineer and certified as completed on the project. Compensation will begin the day Temporary Traffic Detection Technology is placed into operation and approved by the Engineer and will end the day the permanent detection is operational and approved by the Engineer.

102-11.20 Work Zone Pavement Markings: The quantities, furnished and installed, to be paid for will be the length of skip and solid pavement markings, and the area of pavement markings placed as follows:

- a) The total transverse distance, in feet, of skip pavement marking authorized and acceptably applied. The length of actual applied line will depend on the skip ratio of the material used. Measurement will be the distance from the beginning of the first stripe to the end of the last stripe with proper deductions made for unpainted intervals as determined by plan dimensions or stations, subject to 9-1.3.
- b) The net length, in feet, of solid pavement marking authorized and acceptably applied.
- c) The number of directional arrows or pavement messages authorized and acceptably applied.
- d) The number of Temporary RPM's authorized and acceptably applied.

102-11.21 Temporary Raised Rumble Strips: The quantity of temporary raised rumble strip sets to be paid for will be the number of temporary raised rumble strip sets installed and accepted.

102-12 Submittals.

102-12.1 Submittal Instructions: Prepare a certification of quantities, using the Department's current approved form, for certified Maintenance of Traffic payment items for each project in the Contract. Submit the certification of quantities to the Engineer. The Department will not pay for any disputed items until the Engineer approves the certification of quantities.

102-12.2 Contractor's Certification of Quantities: Request payment by submitting a certification of quantities no later than Twelve O'clock noon Monday after the estimate cut-off date or as directed by the Engineer, based on the amount of work done or completed. Ensure the certification consists of the following:

- a) Contract Number, FPID Number, Certification Number, Certification Date and the period that the certification represents.
- b) The basis for arriving at the amount of the progress certification, less payments previously made and less an amount previously retained or withheld. The basis will include a detail breakdown provided on the certification of items of payment in accordance with 102-13. After the initial setup of the maintenance of traffic items and counts, the interval for recording the counts will be made weekly on the certification sheet unless there is a change. This change will be documented on the day of occurrence. Some items may necessitate a daily interval of recording the counts.

102-13 Basis of Payment.

102-13.1 Maintenance of Traffic (General Work): When an item of work is included in the proposal, price and payment will be full compensation for all work and costs specified under this Section ~~except as may be specifically covered for payment under other items~~. All other items included in this specification, including but not limited to temporary detour signs, flaggers, and other maintenance of traffic items included in the plans shall be included in this item.

~~**102-13.2 Traffic Control Officers:** Price and payment will be full compensation for the services of the traffic control officers.~~

~~**102-13.3 Special Detours:** Price and payment will be full compensation for providing all detour facilities shown on the plans and all costs incurred in carrying out all requirements of this Section for general maintenance of traffic within the limits of the detour, as shown on the plans.~~

~~**102-13.4 Commercial Materials for Driveway Maintenance:** Price and payment will be full compensation for all work and materials specified for this item, including specifically all required shaping and maintaining of driveways.~~

~~**102-13.5 Work Zone Signs:** Price and payment will be full compensation for all work and materials for furnishing signs, supports and necessary hardware, installation, relocating, maintaining and removing signs.~~

~~**102-13.6 Business Signs:** Price and payment will be full compensation for all materials and labor required for furnishing, installing, relocating, maintaining, and removing the signs as well as the cost of installing any logos provided by business owners.~~

~~**102-13.7 High Intensity Warning Lights:** Price and payment will be full compensation for furnishing, installing, operating, relocating, maintaining and removing high intensity flashing lights (Type B).~~

~~**102-13.8 Channelizing Devices:** Prices and payment will be full compensation for furnishing, installing, relocating, maintaining and removing the channelizing devices, including the costs associated with attached warning lights as required.~~

~~**102-13.9 Barrier Wall (Temporary):** Price and payment will be full compensation for furnishing, installing, maintaining, and removing the barrier. When called for, Barrier Wall (Temporary) (Relocate) will be full compensation for relocating the barrier.~~

~~**102-13.10 Lights, Temporary, Barrier Wall Mount:** Price and payment will be full compensation for all work and materials for furnishing, installing and maintaining the warning lights mounted on barrier wall. Payment will not be made for lights that are improperly placed or are not working.~~

~~**102-13.11 Glare Screen (Temporary):** Price and payment will be full compensation for furnishing, installing, maintaining, and removing the glare screen certified as installed/used on the project. When called for, Glare Screen (Relocate) will be full compensation for relocating the glare screen.~~

102-13.12 Temporary Crash Cushion:

~~**102-13.12.1 Redirective:** Price and payment will be full compensation for furnishing, installing, maintaining and subsequently removing such crash cushions. Payment for restoring damaged crash cushions will be the manufacturer's/distributor's invoice price for the new materials/parts plus 20% markup. The 20% markup is compensation for all necessary work, including but not limited to labor, equipment, supplies and profit, as authorized by the Engineer. Additional MOT required for the repair of the crash cushion will be paid for under the appropriate MOT pay item.~~

~~**102-13.12.2 Inertia:** Price and payment for the number of complete arrays will be full compensation for furnishing, installing, maintenance and removal at each specified location. In addition, payment will be made for new modules replaced due to damages, excluding damage caused by the Contractor's operations.~~

~~**102-13.13 Temporary Guardrail:** Price and payment will be full compensation for furnishing all materials required for a complete installation, including end anchorage assemblies and any end connections to other structures and for installing, maintaining and removing guardrail.~~

~~**102-13.14 Advance Warning Arrow Panel:** Price and payment will be full compensation for furnishing, installing, operating, relocating, maintaining and removing advance warning arrow panels.~~

~~**102-13.15 Portable Changeable Message Sign:** Price and payment will be full compensation for furnishing, installing, operating, relocating, maintaining and removing portable changeable message signs.~~

~~**102-13.16 Portable Regulatory Signs:** Price and payment will be full compensation for furnishing, installing, relocating, maintaining and removing a completely functioning system as described in these specifications portable regulatory signs. Price and payment will be full compensation for furnishing, installing, operating, relocating, maintaining and removing portable regulatory signs.~~

~~Payment will include all labor, materials, incidentals, repairs and any actions necessary to operate and maintain the unit at all times that work is being performed or traffic is being affected by construction and/or maintenance of traffic operations.~~

102-13.17 Radar Speed Display Unit: Price and payment will be made only for a completely functioning system as described in these specifications. Payment will include all labor, hardware, accessories, signs, and incidental items necessary for a complete system. Payment will include any measurements needed to insure that the unit conforms to all specification requirements.

~~Payment will include all labor, materials, incidentals, repairs and any actions necessary to operate and maintain the unit at all times that work is being performed or traffic is being affected by construction and/or maintenance of traffic operations. Price and payment will be full compensation for furnishing, installing, operating, relocating, maintaining and removing radar speed display unit.~~

102-13.18 Temporary Traffic Control Signals: Price and payment will constitute full compensation for furnishing, installing, operating, maintaining and removing temporary traffic control signals including all equipment and components necessary to provide an operable traffic signal.

102-13.19 Temporary Traffic Detection Technology: Price and payment of per intersection/per day will constitute full compensation for furnishing, installing, operating, maintaining and removing temporary traffic detection technology including all equipment and components necessary to provide an acceptable signalized intersection. Take ownership of all equipment and components.

102-13.20 Temporary Raised Rumble Strips: Price and payment will be full compensation for all work and materials described in this Section, including all cleaning and preparing of surfaces, disposal of all debris, furnishing of all materials, application, curing, removal, reinstalling and protection of all items, protection of traffic, furnishing of all tools, machines and equipment, and all incidentals necessary to complete the work.

102-13.21 Work Zone Pavement Markings: Price and payment will be full compensation for all work specified including, all cleaning and preparing of surfaces, furnishing of all materials, application, curing and protection of all items, protection of traffic, furnishing of all tools, machines and equipment, and all incidentals necessary to complete the work. Final payment will be withheld until all deficiencies are corrected.

~~Removable Tape may be substituted for work zone paint at no additional cost to the Department.~~

~~Payment for Temporary Retroreflective Pavement Markers used to supplement line markings will be paid for under Temporary Retroreflective Pavement Markers. Install these markers as detailed in the Design Standards.~~

102-13.22 Payment Items: Payment will be made under:

Item No. 102-1 Maintenance of Traffic – per Lump Sum (LS)

**SECTION 104
PREVENTION, CONTROL, AND ABATEMENT OF
EROSION AND WATER POLLUTION**

104-1 Description. Provide erosion control measures on the project and in areas outside the right-of-way where work is accomplished in conjunction with the project, so as to prevent pollution of water, detrimental effects to public or private property adjacent to the project right-of-way and damage to work on the project. Construct and maintain temporary erosion control features or, where practical, construct and maintain permanent erosion control features as shown in the plans or as may be directed by the Engineer.

104-2 General. Coordinate the installation of temporary erosion control features with the construction of the permanent erosion control features to the extent necessary to ensure economical, effective, and continuous control of erosion and water pollution throughout the life of the Contract.

Due to unanticipated conditions, the Engineer may direct the use of control features or methods other than those included in the original Contract. In such event, the Department will pay for this additional work as unforeseeable work.

104-3 Control of Contractor's Operations Which May Result in Water Pollution. Prevent pollution of streams, canals, lakes, reservoirs, and other water impoundments with fuels, oils, bitumens, calcium chloride, or other harmful materials. Also, conduct and schedule operations to avoid or otherwise minimize pollution or siltation of such water impoundments, and to avoid interference with movement of migratory fish. Do not dump any residue from dust collectors or washers into any live stream.

Restrict construction operations in rivers, streams, lakes, tidal waters, reservoirs, canals, and other water impoundments to those areas where it is necessary to perform filling or excavation to accomplish the work shown in the plans and to those areas which must be entered to construct temporary or permanent structures. As soon as conditions permit, promptly clear rivers, streams, and impoundments of all obstructions placed therein or caused by construction operations.

Do not frequently ford live streams with construction equipment. Wherever an appreciable number of stream crossings are necessary at any one location, use a temporary bridge or other structure.

Except as necessary for construction, do not deposit excavated material in rivers, streams, canals, or impoundments, or in a position close enough thereto, to be washed away by high water or runoff.

Where pumps are used to remove highly turbid waters from enclosed construction areas such as cofferdams or forms, treat the water by one or more of the following methods prior to discharge into State waters: pumping into grassed swales or appropriate vegetated areas or sediment basins, or confined by an appropriate enclosure such as turbidity barriers when other methods are not considered appropriate.

Do not disturb lands or waters outside the limits of construction as staked, except as authorized by the Engineer.

Obtain the Engineer's approval for the location of, and method of operation in, borrow pits, material pits, and disposal areas furnished for waste material from the project (other than commercially operated

sources) such that erosion during and after completion of the work will not result in probability of detrimental siltation or water pollution.

104-4 Materials for Temporary Erosion Control. The Engineer will not require testing of materials used in construction of temporary erosion control features other than as provided for geotextile fabric in 985-3 unless such material is to be incorporated into the completed project. When no testing is required, the Engineer will base acceptance on visual inspection.

The Contractor may use new or used materials for the construction of temporary silt fence, staked turbidity barriers, and floating turbidity barrier not to be incorporated into the completed project, subject to the approval of the Engineer.

104-5 Preconstruction Requirements. At the Preconstruction Conference, provide to the Department an Erosion Control Plan meeting the requirements or special conditions of all permits authorizing project construction. If no permits are required or the approved permits do not contain special conditions or specifically address erosion and water pollution, the project Erosion Control Plan will be governed by 7-1.1, 7-2.2, 7-8.1, 7-8.2, and Section 104.

When a DEP generic permit is issued, the Contractor's Erosion Control Plan shall be prepared to accompany the Department's Stormwater Pollution Prevention Plan (SWPPP). Ensure the Erosion Control Plan includes procedures to control off-site tracking of soil by vehicles and construction equipment and a procedure for cleanup and reporting of non-storm water discharges, such as contaminated groundwater or accidental spills. Do not begin any soil disturbing activities until Department approval of the Contractor's Erosion Control Plan, including required signed certification statements.

Failure to sign any required documents or certification statements will be considered a default of the Contract. Any soil disturbing activities performed without the required signed documents or certification statements may be considered a violation of the DEP Generic Permit.

When the SWPPP is required, prepare the Erosion Control Plan in accordance with the planned sequence of operations and present in a format acceptable to the Department. The Erosion Control Plan shall describe, but not be limited to, the following items or activities:

- 1) For each phase of construction operations or activities, supply the following information:
 - a) Locations of all erosion control devices
 - b) Types of all erosion control devices
 - c) Estimated time erosion control devices will be in operation
 - d) Monitoring schedules for maintenance of erosion control devices
 - e) Methods of maintaining erosion control devices
 - f) Containment or removal methods for pollutants or hazardous wastes
- 2) The name and telephone number of the person responsible for monitoring and maintaining the erosion control devices.

- 3) Submit for approval the Erosion Control Plans meeting paragraphs 3a, 3b, or 3c below:
- a) Projects permitted by the Southwest Florida Water Management District (SWFWMD), require the following:
 - i. Submit a copy of the Erosion Control Plan to the Engineer for review and to the appropriate SWFWMD Office for review and approval. Include the SWFWMD permit number on all submitted data or correspondence.
 - ii. The Contractor may schedule a meeting with the appropriate SWFWMD Office to discuss his Erosion Control Plan in detail, to expedite the review and approval process. Advise the Engineer of the time and place of any meetings scheduled with SWFWMD.
 - iii. Do not begin construction activities until the Erosion Control Plan receives written approval from both SWFWMD and the Engineer.
 - (b) Projects permitted by the South Florida Water Management District or the St. Johns River Water Management District, require the following:
 - i. Obtain the Engineer's approval of the Erosion Control Plan.
 - ii. Do not begin construction activities until the Erosion Control Plan receives written approval from the Engineer.
 - (c) Projects authorized by permitting agencies other than the Water Management Districts or projects for which no permits are required require the following:
 - i. The Engineer will review and approve the Contractor's Erosion Control Plan.
 - ii. Do not begin construction activities until the Erosion Control Plan receives written approval from the Engineer.
 - iii. Comply with the approved Erosion Control Plan.

104-6 Construction Requirements.

104-6.1 Limitation of Exposure of Erodible Earth: The Engineer may limit the surface areas of unprotected erodible earth exposed by the construction operation and may direct the Contractor to provide erosion or pollution control measures to prevent contamination of any river, stream, lake, tidal waters, reservoir, canal, or other water impoundments or to prevent detrimental effects on property outside the project right-of-way or damage to the project. Limit the area in which excavation and filling operations are being performed so that it does not exceed the capacity to

keep the finish grading, turf, sod, and other such permanent erosion control measures current in accordance with the accepted schedule.

Do not allow the surface area of erodible earth that clearing and grubbing operations or excavation and filling operations expose to exceed 750,000 square feet without specific prior approval by the Engineer. This limitation applies separately to clearing and grubbing operations and excavation and filling operations.

The Engineer may increase or decrease the amount of surface area the Contractor may expose at any one time.

104-6.2 Incorporation of Erosion and Sediment Control Features: Incorporate permanent erosion control features into the project at the earliest practical time. Use temporary erosion and sediment control features found in the State of Florida Erosion and Sediment Control Designer and Reviewer Manual (E&SC Manual) to correct conditions that develop during construction which were not foreseen at the time of design, to control erosion and sediment prior to the time it is practical to construct permanent control features, or to provide immediate temporary control of erosion and sediment that develops during normal construction operations, which are not associated with permanent erosion control features on the project. An electronic version of the E&SC Manual can be found at the following URL:

www.dot.state.fl.us/specificationsoffice/Implemented/URLInSpecs/Files/FLerosionSedimentManual.pdf

Install all sediment control devices in a timely manner to ensure the control of sediment and the protection of lakes, streams, gulf or ocean waters, or any wetlands associated therewith and to any adjacent property outside the right-of-way as required.

At sites where exposure to such sensitive areas is prevalent, complete the installation of any sediment control device prior to the commencement of any earthwork.

After installation of sediment control devices, repair portions of any devices damaged at no expense to the Department. The Engineer may authorize temporary erosion and sediment control features when finished soil layer is specified in the Contract and the limited availability of that material from the grading operations will prevent scheduled progress of the work or damage the permanent erosion control features.

104-6.3 Scheduling of Successive Operations: Schedule operations such that the area of unprotected erodible earth exposed at any one time is not larger than the minimum area necessary for efficient construction operations, and the duration of exposure of uncompleted construction to the elements is as short as practicable.

Schedule and perform clearing and grubbing so that grading operations can follow immediately thereafter. Schedule and perform grading operations so that permanent erosion control features can follow immediately thereafter if conditions on the project permit.

104-6.4 Details for Temporary Erosion and Sediment Control Features:

104-6.4.1 General: Use temporary erosion, sediment and water pollution control features found in the E&SC Manual. These features consist of, but are not limited to, temporary turf, rolled erosion

control products, sediment containment systems, runoff control structures, sediment barriers, inlet protection systems, silt fences, turbidity barriers, and chemical treatment. For design details for some of these items, refer to the Design Standards and E&SC Manual.

104-6.4.2 Temporary Turf: The Engineer may designate certain areas of turf or sod constructed in accordance with Section 570 as temporary erosion control features. For areas not defined as sod, constructing temporary turf by seeding only is not an option for temporary erosion control under this Section. The Engineer may waive the turf establishment requirements of Section 570 for areas with temporary turf that will not be a part of the permanent construction.

104-6.4.3 Runoff Control Structures: Construct runoff control structures in accordance with the details shown in the plans, the E&SC Manual, or as may be approved as suitable to adequately perform the intended function.

104-6.4.4 Sediment Containment Systems: Construct sediment containment systems in accordance with the details shown in the plans, the E&SC Manual, or as may be approved as suitable to adequately perform the intended function. Clean out sediment containment systems as necessary in accordance with the plans or as directed.

104-6.4.5 Sediment Barriers: Provide and install sediment barriers according to details shown in the plans, as directed by the Engineer, or as shown in the E&SC Manual to protect against downstream accumulation of sediment. Sediment Barriers include, but are not limited to synthetic bales, silt fence, fiber logs and geosynthetic barriers. Reusable barriers that have had sediment deposits removed may be reinstalled on the project as approved by the Engineer.

104-6.4.6 Silt Fence:

104-6.4.6.1 General: Furnish, install, maintain, and remove silt fences, in accordance with the manufacturer's directions, these Specifications, the details as shown on the plans, the Design Standards, and the E&SC Manual.

104-6.4.6.2 Materials and Installation: Use a geotextile fabric made from woven or nonwoven fabric, meeting the physical requirements of Section 985 according to those applications for erosion control.

Choose the type and size of posts, wire mesh reinforcement (if required), and method of installation. Do not use products which have a separate layer of plastic mesh or netting. Provide a durable and effective silt fence that controls sediment comparable to the Design Standards and the E&SC Manual.

Erect silt fence at upland locations, across ditchlines and at temporary locations shown on the plans or approved by the Engineer where continuous construction activities change the natural contour and drainage runoff. Do not attach silt fence to existing trees unless approved by the Engineer.

104-6.4.6.3 Inspection and Maintenance: Inspect all silt fences immediately after each rainfall and at least daily during prolonged rainfall. Immediately correct any deficiencies. In addition, make a daily review of the location of silt fences in areas where construction activities have changed the natural contour and drainage runoff to ensure that the silt fences are properly located for effectiveness. Where deficiencies exist, install additional silt fences as directed by the Engineer.

Remove sediment deposits when the deposit reaches approximately 1/2 of the volume capacity of the silt fence or as directed by the Engineer. Dress any sediment deposits remaining in place after the silt fence is no longer required to conform with the finished grade, and prepare and seed them in accordance with Section 570.

104-6.4.7 Floating Turbidity Barriers and Staked Turbidity Barriers: Install, maintain, and remove turbidity barriers to contain turbidity that may occur as the result of dredging, filling, or other construction activities which may cause turbidity to occur in the waters of the State. The Contractor may need to deploy turbidity barriers around isolated areas of concern such as seagrass beds, coral communities, etc. both within as well as outside the right-of-way limits. The Engineer will identify such areas. Place the barriers prior to the commencement of any work that could impact the area of concern. Install the barriers in accordance with the details shown in the plans or as approved by the Engineer. Ensure that the type barrier used and the deployment and maintenance of the barrier will minimize dispersion of turbid waters from the construction site. The Engineer may approve alternate methods or materials.

Operate turbidity barriers in such a manner to avoid or minimize the degradation of the water quality of the surrounding waters and minimize damage to areas where floating barriers installed.

104-6.4.8 Inlet Protection System: Furnish and install inlet protection systems as shown in the plans, Design Standards and the E&SC Manual.

104-6.4.9 Rolled Erosion Control Products (RECPs):

104-6.4.9.1 General: Install RECPs in locations where temporary protection from erosion is needed. Two situations occur that require artificial coverings. The two situations have differing material requirements, which are described below.

(1) Use RECPs composed of natural or synthetic fiber mats, plastic sheeting, or netting as protection against erosion, when directed by the Engineer, during temporary pauses in construction caused by inclement weather or other circumstances. Remove the material when construction resumes.

(2) Use RECPs as erosion control blankets, at locations shown in the plans, to facilitate plant growth while permanent grassing is being established. For the purpose described, use non-toxic, biodegradable, natural or synthetic woven fiber mats. Install erosion control blankets capable of sustaining a maximum design velocity of 6.5 ft/sec as determined from tests performed by Utah State University, Texas Transportation Institute or an independent testing laboratory approved by the Department. Furnish to the Engineer, two certified

copies of manufacturers test reports showing that the erosion control blankets meet the requirements of this Specification. Certification must be attested, by a person having legal authority to bind the manufacturing company. Also, furnish two 4 by 8 inch samples for product identification. The manufacturers test records shall be made available to the Department upon request. Leave the material in place, as installed, to biodegrade.

104-6.4.10 Chemical Treatment: Provide chemical treatment in accordance with the E&SC Manual. Chemical treatment may be used to clarify turbid or sediment laden water that does not yet meet state water quality standards or as an amendment to other erosion prevention and sediment control products to aid in their performance. The contractor must provide all of the required toxicity testing information in accordance with the E&SC Manual to the Engineer for review and acceptance prior to using any chemical treatment on the project site.

104-6.5 Removal of Temporary Erosion Control Features: In general, remove or incorporate into the soil any temporary erosion control features existing at the time of construction of the permanent erosion control features in an area of the project in such a manner that no detrimental effect will result. The Engineer may direct that temporary features be left in place.

104-7 Maintenance of Erosion and Sediment Control Features.

104-7.1 General: Provide routine maintenance of permanent and temporary erosion and sediment control features, at no expense to the Department, until the project is complete and accepted. If reconstruction of such erosion and sediment control features is necessary due to the Contractor's negligence or carelessness or, in the case of temporary erosion and sediment control features, failure by the Contractor to install permanent erosion control features as scheduled, the Contractor shall replace such erosion control features at no expense to the Department. If reconstruction of permanent or temporary erosion and sediment control features is necessary due to factors beyond the control of the Contractor, the Department will pay for replacement under the appropriate Contract pay item or items.

Inspect all erosion and sediment control features at least once every seven calendar days and within 24 hours of the end of a storm of 0.50 inches or greater. Maintain all erosion control features as required in the Stormwater Pollution Prevention Plan, Contractor's Erosion Control plan and as specified in the State of Florida Department of Environmental Protection Generic Permit for Stormwater Discharge from Large and Small Construction Activities.

104-8 Protection During Suspension of Contract Time. If it is necessary to suspend the construction operations for any appreciable length of time, shape the top of the earthwork in such a manner to permit runoff of rainwater, and construct earth berms along the top edges of embankments to intercept runoff water. Provide temporary slope drains to carry runoff from cuts and embankments that are in the vicinity of rivers, streams, canals, lakes, and impoundments. Locate slope drains at intervals of approximately 500 feet, and stabilize them by paving or by covering with waterproof materials. Should such preventive measures fail, immediately take such other action as necessary to effectively prevent erosion and siltation. The Engineer may direct the Contractor to perform, during such suspensions of operations, any other erosion and sediment control work deemed necessary.

104-9 Method of Measurement. When separate items for temporary erosion control features are included in the Contract, the quantities to be paid for will be: (1) the area, in square yards, of Rolled Erosion Control

Products; (2) the length, in feet, of Runoff Control Structures, measured along the surface of the work constructed; (3) the number of Sediment Containment Systems constructed and accepted; (4) the number of Sediment Containment System Cleanouts accomplished and accepted; (5) the length, in feet, of Sediment Barriers; (6) the length, in feet, of Floating Turbidity Barrier; (7) the length, in feet, of Staked Turbidity Barrier; (8) the number of inlet protection systems; (9) the area, in square yards, of chemical treatment.(10) the number of floc logs or drums of product for chemical treatment.

Upon acceptance by the Engineer, the quantity of floating turbidity barriers, sediment barriers, staked turbidity barriers, and inlet protection devices will be paid for regardless of whether materials are new, used, or relocated from a previous installation on the project.

104-10 Basis of Payment. Prices and payments will be full compensation for all work specified in this Section, including construction and routine maintenance of temporary erosion control features.

Any additional costs resulting from compliance with the requirements of this Section, other than construction, routine maintenance, and removal of temporary erosion control features, will be included in the Contract unit prices for the item or items to which such costs are related. The work of Performance Turf designated as a temporary erosion control feature in accordance with 104-6.4.2 will be paid for under the appropriate pay items specified in Sections 570 and 580.

Separate payment will not be made for the cost of constructing temporary earth berms along the edges of the roadways to prevent erosion during grading and subsequent operations. The Contractor shall include these costs in the Contract prices for grading items.

Additional temporary erosion control features constructed as directed by the Engineer will be paid for as unforeseeable work.

In case of repeated failure on the part of the Contractor to control erosion, pollution, or siltation, the Engineer reserves the right to employ outside assistance or to use the Department's own forces to provide the necessary corrective measures. Any such costs incurred, including engineering costs, will be charged to the Contractor and appropriate deductions made from the monthly progress estimate.

Payment will be made under:

Item No. 104-1	PREVENTION, CONTROL, AND ABATEMENT OF EROSION AND WATER POLLUTION – per Lump Sum (LS)
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**SECTION 110
CLEARING AND GRUBBING**

110-1 Description. Clear and grub within the areas of the roadway right-of-way and of borrow pits, sand- clay base material pits, lateral ditches, and any other areas shown in the plans to be cleared and grubbed. Remove and dispose of all trees, stumps, roots and other such protruding objects, buildings, structures, appurtenances, existing flexible asphalt pavement, and other facilities necessary to prepare the area for the proposed construction. Remove and dispose of all product and debris not required to be salvaged or not required to complete the construction.

Also, perform certain miscellaneous work the Engineer considers necessary for the complete preparation of the overall project site, as follows:

- (a) Plug any water wells that are encountered within the right-of-way and that are to be abandoned.
- (b) Level the terrain outside the limits of construction for purposes of facilitating maintenance and other post-construction operations in accordance with 110-10.3.
- (c) Trim trees and shrubs within the project right-of-way that are identified in the Contract Documents.

Meet the requirements for such miscellaneous work as specified in 110-10.

110-2 Standard Clearing and Grubbing.

110-2.1 Work Included: Completely remove and dispose of all buildings, timber, brush, stumps, roots, rubbish, debris, and all other obstructions resting on or protruding through the surface of the existing ground and the surface of excavated areas, and all other structures and obstructions necessary to be removed and for which other items of the Contract do not specify the removal thereof, including septic tanks, building foundations, and pipes.

Perform Standard Clearing and Grubbing within the following areas:

- (a) All areas where excavation is to be done, including borrow pits, lateral ditches, right-of-way ditches, etc.
- (b) All areas where roadway embankments will be constructed.
- (c) All areas where structures will be constructed, including pipe culverts and other pipe lines.

110-2.2 Depths of Removal of Roots, Stumps, and Other Debris: In all areas where excavation is to be performed, or roadway embankments are to be constructed, remove roots and other debris to a depth of 12 inches below the ground surface. Remove roots and other debris from all excavated material to be used in the construction of roadway embankment or roadway base. Plow the surface to a depth of at least 6 inches, and remove all roots thereby exposed to a depth of at least 12 inches. Completely remove and dispose of all stumps within the roadway right-of-way.

Remove all roots, etc., protruding through or appearing on the surface of the completed excavation within the roadway area and for structures, to a depth of at least 12 inches below the finished

excavation surface.

Remove or cut off all stumps, roots, etc., below the surface of the completed excavation in borrow pits, material pits, and lateral ditches.

In borrow and material pits, do not perform any clearing or grubbing within 3 feet inside the right-of-way line.

Within all other areas where Standard Clearing and Grubbing is to be performed remove roots and other debris projecting through or appearing on the surface of the original ground to a depth of 12 inches below the surface, but do not plow or harrow these areas.

110-2.3 Trees to Remain: As an exception to the above provisions, where so directed by the Engineer, trim, protect, and leave standing desirable trees within the roadway area. Trim branches of trees extending over the area occupied by the roadway as directed, to give a clear height of 16 feet above the roadway.

110-2.4 Boulders: Remove any boulders encountered in the roadway excavation (other than as permitted under the provisions of 120-7.2) or found on the surface of the ground. When approved by the Engineer place boulders in neat piles inside the right of way. The Contractor may stockpile boulders encountered in Department-furnished borrow areas, which are not suitable for use in the embankment construction, within the borrow area.

110-3 Selective Clearing and Grubbing.

The Contractor shall remove and dispose of all vegetation, obstructions, etc., as provided above except that, where so elected, the Contractor may cut roots, etc., flush with the ground surface. Completely remove and dispose of stumps. Entirely remove undergrowth except in specific areas designated by the Engineer to remain for aesthetic purposes. Trim, protect, and leave standing desirable trees, with the exception of such trees as the Engineer may designate to be removed in order to facilitate right-of-way maintenance. Remove undesirable or damaged trees as so designated by the Engineer. Perform Selective Clearing and Grubbing only in areas so designated in the plans.

110-4 Protection of Property Remaining in Place.

Protect and do not displace property obstructions which are to remain in place, such as buildings, sewers, drains, water or gas pipes, conduits, poles, walls, posts, bridges, etc.

110-5 Removal of Buildings.

110-5.1 Parts to be Removed: Completely remove all parts of the buildings, including utilities, plumbing, foundations, floors, basements, steps, connecting concrete sidewalks or other pavement, septic tanks, and any other appurtenances, by any practical manner which is not detrimental to other property and improvements. Remove utilities to the point of connection to the utility authority's cut-in. After removing the sewer connections to the point of cut-in, construct a concrete plug at the cut-in point, as directed by the Engineer, except where the utility owners may elect to perform their own plugging. Contact the appropriate utility companies prior to removal of any part of the building to ensure disconnection of services.

110-5.2 Removal by Others: Where buildings within the area to be cleared and grubbed are so specified to be removed by others, remove and dispose of any foundations, curtain walls, concrete floors, basements or other foundation parts which might be left in place after such removal of buildings by others.

110-6 Removal of Existing Structures.

110-6.1 Structures to be Removed: Remove and dispose of the materials from existing structures. Remove the following: (1) those structures, or portions of structures, shown in the plans to be removed; (2) those structures, or portions of structures, found within the limits of the area to be cleared and grubbed, and directed by the Engineer to be removed; (3) those structures, or portion of structures, which are necessary to be removed in order to construct new structures; and (4) other appurtenances or obstructions which may be designated in the Contract Documents as to be included in an item of payment for the work under this Article.

Provide detailed schedule information to the Engineer 15 working days prior to the commencement of any demolition or renovation of any structures, even if asbestos is not found on the project, for the Engineer's use in notifying the Department of Environmental Protection (DEP) on DEP Form 62-257.900(1) "Notice of Asbestos Renovation or Demolition".

110-6.2 Method of Removal:

110-6.2.1 General: Remove the structures in such a way so as to leave no obstructions to any proposed new structures or to any waterways. Pull, cut off, or break off pilings to the requirements of the permit or other Contract Documents, whichever requires the deepest removal, but not less than 2 feet below the finish ground line. In the event that the plans indicate channel excavation to be done by others, consider the finish ground line as the limits of such excavation. For materials which are to remain the property of the Department or are to be salvaged for use in temporary structures, avoid damage to such materials, and entirely remove all bolts, nails, etc. from timbers to be so salvaged. Mark structural steel members for identification as directed.

110-6.2.2 Removal of Steel Members With Hazardous Coatings: Provide to the Engineer for approval, a copy of the "Contractor's Lead in Construction Compliance Program" from the firm actually removing and disposing of these steel members before any members are disturbed.

Vacuum power tool clean any coated steel member to bare metal as defined by SSPC-SP11 a minimum of 4 inches either side of any area to be heated (torch cutting, sawing, grinding, etc.) in accordance with 29 CFR 1926.354. Abrasive blasting is prohibited.

Provide air supplied respirators in accordance with 29 CFR 1926.62 and 29 CFR 1910.134.

110-6.3 Partial Removal of Bridges: On concrete bridges to be partially removed and widened, remove concrete by manually or mechanically operated pavement breakers, by concrete saws, by chipping hammers, or by hydro-demolition methods. Do not use explosives. Where concrete is to be removed to neat lines, use concrete saws or hydro-demolition methods capable of providing a reasonably uniform

cleavage face. If the equipment used will not provide a uniform cut without surface spalling, first score the outlines of the work with small trenches or grooves. For all demolition methods, submit for review and approval of the Engineer, a demolition plan that describes the method of removal, equipment to be used, types of rebar splices or couplers, and method of straightening or cutting rebars. In addition, for hydro-demolition, describe the method for control of water or slurry runoff and measures for safe containment of concrete fragments that are thrown out by the hydro-demolition machine.

110-6.4 Authority of U.S. Coast Guard: For structures in navigable waters, when constructing the project under authority of a U.S. Coast Guard permit, the U.S. Coast Guard may inspect and approve the work to remove any existing structures involved therein, prior to acceptance by the Department.

110-6.5 Asbestos Containing Materials (ACM) Not Identified Prior to the Work: When encountering or exposing any condition indicating the presence of asbestos, cease operations immediately in the vicinity and notify the Engineer.

Make every effort to minimize the disturbance of the ACM. Immediately provide for the health and safety of all workers at the job site and make provisions necessary for the health and safety of the public that may be exposed to any potentially hazardous conditions. Provisions shall meet all applicable laws, rules or regulations covering hazardous conditions and will be in a manner commensurate with the gravity of the conditions.

The Engineer will notify the District Contamination Assessment Coordinator who will coordinate selecting and tasking the Department's Asbestos Contractor or Contamination Assessment/Remediation Contractor (CAR). Provide access to the potential contamination area. Preliminary investigation by the Asbestos/CAR Contractor will determine the course of action necessary for site security and the steps necessary to resolve the contamination issue.

The Asbestos/CAR Contractor will delineate the contamination area(s), any staging or holding area required. Coordinate with the Asbestos/CAR Contractor and the Engineer to develop a work plan that will provide the Asbestos/CAR Contractor's operations schedule with projected completion dates for the final resolution of the contamination issue.

The Asbestos/CAR Contractor will maintain jurisdiction over activities inside any outlined contaminated areas and any associated staging holding areas. The Asbestos/CAR Contractor will be responsible for the health and safety of workers within the delineated areas. Provide continuous access to these areas for the Asbestos/CAR Contractor and representatives of regulatory or enforcement agencies having jurisdiction.

Both Contractors will use the schedule as a basis for planning the completion of both work efforts. The Engineer may grant the Contract Time extensions according to the provisions of 8-7.3.2.

Cooperate with the Asbestos/CAR Contractor to expedite integration of the Asbestos/CAR Contractor's operations into the construction project. The Prime Contractor is not expected to engage in routine construction activities involving asbestos containing materials. Adjustments to quantities or to Contract unit prices will be made according to work additions or reductions on the part of the Prime Contractor in

accordance with 4-3.

The Engineer will direct the Prime Contractor when operations may resume in the affected area.

110-7 Removal of Existing Pavement.

Remove and dispose of existing rigid portland cement concrete pavement, sidewalk, slope pavement, ditch pavement, curb, and curb and gutter etc., where shown in the plans or ordered by the Engineer to be removed or where required because of the construction operations. Retaining walls, drainage structures and flexible asphalt pavement are not included in the work under this Article.

110-8 Ownership of Materials.

Except as may be otherwise specified in the Contract Documents, the Contractor shall take ownership of all buildings, structures, appurtenances, and other materials removed by him and shall dispose of them in accordance with 110-9.

110-9 Disposal of Materials.

110-9.1 General: Either stack materials designated to remain the property of the Department in neat piles within the right-of-way or load onto the Department's vehicles.

Dispose of timber, stumps, brush, roots, rubbish, and other objectionable material resulting from clearing and grubbing in areas and by methods meeting the applicable requirements of all Local, State and Federal regulations. Do not block waterways by the disposal of debris.

110-9.2 Burning Debris: Where burning of such materials is permitted, perform all such burning in accordance with the applicable laws, ordinances, and regulations. Perform all burning at locations where trees and shrubs adjacent to the cleared area will not be harmed.

110-9.3 Timber and Crops: The Contractor may sell any merchantable timber, fruit trees, and crops that are cleared under the operations of clearing and grubbing for his own benefit, subject to the provisions of 7-1.2, which may require that the timber, fruit trees, or crops be burned at or near the site of their removal, as directed by the Engineer. The Contractor is liable for any claims which may arise pursuant to the provisions of this Subarticle.

110-9.4 Disposal of Treated Wood: Treated wood, including that which comes from bridge channel fender systems, must be handled and disposed of properly during removal. Treated wood should not be cut or otherwise mechanically altered in a manner that would generate dust or particles without proper respiratory and dermal protection. The treated wood must be disposed of in at least a lined solid waste facility or through recycling/reuse. Treated wood shall not be disposed by burning or placement in a construction and demolition (C&D) debris landfill. All compensation for the cost of removal and disposal of treated wood will be included in the Cost of Removal of Existing Structures.

110-9.5 Hazardous Materials/Waste: Handle, transport and dispose of hazardous materials in accordance with all Local, State and Federal requirements including the following:

- a. SSPC Guide 7

- b. Federal Water Pollution Control Act, and
- c. Resource Conservation and Recover Act (RCRA).

Accept responsibility for the collection, sampling, classification, packaging, labeling, accumulation time, storage, manifesting, transportation, treatment and disposal of hazardous waste, both solid and liquid. Separate all solid and liquid waste and collect all liquids used at hygiene stations and handle as hazardous materials/waste. Obtain written approval from the Engineer for all hazardous materials/waste stabilization methods before implementation.

Obtain an EPA/FDEP Hazardous Waste Identification Number (EPA/FDEP ID Number) before transporting and/or disposal of any hazardous materials/waste.

List the Department as the generator of all hazardous materials/waste.

Submit the following for the Engineers' approval before transporting, treatment or disposal of any hazardous materials/waste:

- a. Name, address and qualifications of the transporter,
- b. Name, address and qualifications of the treatment facility,
- c. Proposed treatment and/or disposal of all Hazardous Materials/Waste. Transport all hazardous materials/waste in accordance with applicable 40 CFR 263 Standards. Provide a copy of all completed Hazardous Materials/Waste manifest/bills of lading to the Engineer within 21 days of each shipment.

110-9.5.1 Steel Members With Hazardous Coating: Dispose of steel members with hazardous coating in one of the following manners:

- (a) Deliver the steel members and other hazardous waste to a licensed recycling or treatment facility capable of processing steel members with hazardous coating.
- (b) Deliver the steel members with hazardous coating to a site designated by the Engineer for use as an offshore artificial reef. Deliver any other hazardous materials/waste to a licensed hazardous materials/waste recycling treatment facility.

Dismantle and/or cut steel members to meet the required dimensions of the recycling facility, treatment facility or offshore artificial reef agency.

All compensation for the cost of removal and disposal of hazardous materials/waste will be included in the Cost of Removal of Existing Structures.

110-9.5.2 Certification of Compliance: Furnish two copies of Certification of Compliance from the firm actually removing and disposing of the hazardous materials/waste stipulating, the hazardous materials/waste has been handled, transported and disposed of in accordance with this Specification. The Certification of Compliance shall be attested to by a person having legal authority to bind the company.

Maintain all records required by this Specification and ensure these records are available to the Department upon request.

110-10 Miscellaneous Operations.

110-10.1 Water Wells Required to be Plugged: Fill or plug all water wells within the right-of-way, including areas of borrow pits and lateral ditches, that are not to remain in service, in accordance with applicable Water Management District rules or the Department of Environmental Protection regulations.

Cut off the casing of cased wells at least 12 inches below the ground line or 12 inches below the elevation of the finished excavation surface, whichever is lower. Water wells, as referred to herein, are defined either as artesian or non-artesian, as follows:

- (a) An artesian well is an artificial hole in the ground from which water supplies may be obtained and which penetrates any water-bearing rock, the water in which is raised to the surface by natural flow or which rises to an elevation above the top of the water-bearing bed. Artesian wells are further defined to include all holes drilled as a source of water that penetrate any water-bearing beds that are a part of the artesian water system of Florida, as determined by representatives of the applicable Water Management District.
- (b) A non-artesian (water-table) well is a well in which the source of water is an unconfined aquifer. The water in a non-artesian well does not rise above the source bed. When the plans do not indicate whether a non-flowing well is artesian or non-artesian, obtain this information from the Engineer.

110-10.2 Landscape Areas: When certain areas of the right-of-way, outside of the limits of construction, are shown in the plans or designated by the Engineer to be landscaped, either under the construction Contract or at a later time, remove undesirable trees, stumps, undergrowth, and vegetation, as directed, and preserve and trim natural growth and trees as directed by the Engineer.

110-10.3 Leveling Terrain: Within the areas between the limits of construction and the outer limits of clearing and grubbing, fill all holes and other depressions, and cut down all mounds and ridges. Make the area of a sufficient uniform contour so that the Department's subsequent mowing and cutting operations are not hindered by irregularity of terrain. Perform this work regardless of whether the irregularities were the result of construction operations or existed originally.

110-10.4 Mailboxes: When the Contract Documents require furnishing and installing mailboxes, permit each owner to remove the existing mailbox. Work with the Local Postmaster to develop a method of temporary mail service for the period between removal and installation of the new mailboxes. Install the mailboxes in accordance with the Design Standards.

110-11 Method of Measurement.

110-11.1 Clearing and Grubbing: When direct payment is provided in the Contract, the quantity to be

paid for will be the lump sum quantity.

110-11.2 Removal of Existing Structures: When direct payment is provided in the Contract, the quantity to be paid for will be the lump sum quantity or quantities for the specific structures removed, as designated.

110-11.3 Removal of Existing Pavement: Payment for removal of flexible asphalt pavement is included in the Lump Sum price for Clearing and Grubbing. When a separate item for Removal of Existing Pavement is provided, the quantity to be paid for will be the number of square yards of existing pavement of the types listed in 110-7, acceptably removed and disposed of, as specified. The quantity will be determined by actual measurement along the surface of the pavement before its removal. Measurements for appurtenances which have irregular surface configurations, such as curb and gutter, steps, and ditch pavement, will be the area as projected to an approximate horizontal plane. Where the removal of pavement areas is necessary only for the construction of box culverts, pipe culverts, storm sewers, inlets, manholes, etc., these areas will not be included in the measurements.

110-11.4 Plugging Water Wells: When direct payment is provided in the Contract, the quantity to be paid for will be the number of water wells plugged, for each type of well (artesian or non-artesian).

110-11.5 Mailboxes: When direct payment is provided in the Contract, the quantity to be paid for will be the number of mailboxes acceptably furnished and installed.

110-11.6 Delivery of Salvageable Material to the Department When direct payment is provided in the Contract, the quantity to be paid for will be the Lump Sum quantity for delivery of salvageable materials to the Department as indicated in the plans.

110-11.7 General: In each case, except as provided below, where no item of separate payment for such work is included in the proposal, all costs of such work will be included in the various scheduled items in the Contract, or under specific items as specified herein below or elsewhere in the Contract.

110-12 Basis of Payment.

110-12.1 Clearing and Grubbing:

110-12.1.1 Lump Sum Payment: Price and payment will be full compensation for all clearing and grubbing required for the roadway right-of-way and for lateral ditches, channel changes, or other outfall areas, and any other clearing and grubbing indicated, or required for the construction of the entire project, including all necessary hauling, furnishing equipment, equipment operation, furnishing any areas required for disposal of debris, leveling of terrain and the landscaping work of trimming, etc., as specified herein, except for any areas designated to be paid for separately or to be specifically included in the costs of other work under the Contract.

Where construction easements are specified in the plans and the limits of clearing and grubbing for such easements are dependent upon the final construction requirements, no adjustment will be made in the lump sum price and payment, either over or under, for variations from the limits of the easement defined on the plans.

110-12.1.2 When No Direct Payment is Provided: When no item for clearing and grubbing is included in the proposal, the Contractor shall include the cost of any work of clearing and grubbing which is necessary for the proper construction of the project in the Contract price for the structure or other item of work for which such clearing and grubbing is required.

The Contractor shall include the cost of all clearing and grubbing which might be necessary in pits or areas from which base material is obtained in the Contract price for the base in which such material is used. The clearing and grubbing of areas for obtaining stabilizing materials, where required only for the purpose of obtaining materials for stabilizing, will not be paid for separately.

110-12.2 Removal of Existing Structures: Price and payment will be full compensation for all work of removal and disposal of the designated structures.

When direct payment for the removal of existing structures is not provided in the proposal, the Contractor shall include the cost of removing all structures in the Contract price for Clearing and Grubbing or, if no item of Clearing and Grubbing is included, in the compensation for the other items covering the new structure being constructed.

110-12.3 Removal of Existing Pavement: Price and payment will be full compensation for performing and completing all the work of removal and satisfactory disposal.

When no separate item for this work is provided and no applicable item of excavation or embankment covering such work (as provided in 120-13.1) is included, the Contractor shall include the costs of this work in the Contract price for the item of Clearing and Grubbing or for the pipe or other structure for which the pavement removal is required.

110-12.4 Plugging Water Wells: Price and payment will be full compensation for each type of well acceptably plugged.

If a water well requiring plugging is encountered and the Contract contains no price for plugging wells of that specific type, the plugging of such well will be paid for as unforeseeable work.

110-12.5 Mailboxes: Price and payment will be full compensation for all work and materials required, including supports and numbers.

110-12.6 Delivery of Salvageable Material to the Department: Price and payment will be full compensation for all work required for delivery of the materials to the Department.

110-12.7 Payment Items: Payment will be made under:

<i>Item No. 110- 1-</i>	<i>Complete Concrete and Base Removal – per Square Yard (SY)</i>
<i>Item No. 110- 2-</i>	<i>Misc. Utility/Fence Demolition – per Lump Sum (LS)</i>

**SECTION 120
EXCAVATION AND EMBANKMENT**

120-1 Description.

120-1.1 General: Excavate and construct embankments as required for the roadway, ditches, channel changes and borrow material. Use suitable excavated material or authorized borrow to prepare subgrades and foundations. Construct embankments in accordance with Standard Index 505. Compact and dress excavated areas and embankments.

For excavation and backfilling of structures, comply with the requirements of Section 125. Excavate material for clearing and grubbing in accordance with the requirements of Section 110. Material displaced by the storm sewer or drainage structure system is not included in the earthwork quantities shown on the plans.

120-1.2 Unidentified Areas of Contamination: When encountering or exposing any abnormal condition indicating the presence of hazardous or toxic wastes, or contaminants, cease operations immediately in the vicinity and notify the Engineer. The presence of tanks or barrels; discolored earth, metal, wood, ground water, etc.; visible fumes; abnormal odors; excessively hot earth; smoke; or other conditions that appear abnormal may indicate hazardous or toxic wastes or contaminants and must be treated with extreme caution.

Make every effort to minimize the spread of contamination into uncontaminated areas. Immediately provide for the health and safety of all workers at the job site and make provisions necessary for the health and safety of the public that may be exposed to any potentially hazardous conditions. Ensure provisions adhere to all applicable laws, rules or regulations covering hazardous conditions and will be in a manner commensurate with the gravity of the conditions.

The Engineer will notify the District Contamination Assessment Coordinator who will coordinate selecting and tasking the Department's Contamination Assessment/Remediation Contractor (CAR). Provide access to the potential contamination area. Preliminary investigation by the CAR Contractor will determine the course of action necessary for site security and the steps necessary under applicable laws, rules, and regulations for additional assessment and/or remediation work to resolve the contamination issue.

The CAR Contractor will delineate the contamination area(s), any staging or holding area required, and, in cooperation with the Prime Contractor and Engineer, develop a work plan that will provide the CAR Contractor's operations schedule with projected completion dates for the final resolution of the contamination issue.

The CAR Contractor will maintain jurisdiction over activities inside any outlined contaminated areas and any associated staging holding areas. The CAR Contractor will be responsible for the health and safety of workers within the delineated areas. Provide continuous access to these areas for the CAR Contractor and representatives of regulatory or enforcement agencies having jurisdiction.

Both Contractors will use the schedule as a basis for planning the completion of both work efforts. The Engineer may grant the Contract Time extensions according to the provisions of 8-7.3.2.

Cooperate with the CAR Contractor to expedite integration of the CAR Contractor's operations into the construction project. The Prime Contractor is not expected to engage in routine construction activities, such as excavating, grading, or any type of soil manipulation, or any construction processes required if handling of contaminated soil, surface

water or ground water is involved. All routine construction activities will be by the CAR Contractor. Adjustments to quantities or to Contract unit prices will be made according to work additions or reductions on the part of the Prime Contractor in accordance with 4-3.

The Engineer will direct the Prime Contractor when operations may resume in the affected area.

120-2 Classifications of Excavation.

120-2.1 General: The Department may classify excavation specified under this Section for payment as any of the following: (1) Regular Excavation, (2) Subsoil Excavation, (3) Lateral Ditch Excavation, and (4) Channel Excavation.

If the proposal does not show Subsoil Excavation or Lateral Ditch Excavation as separate items of payment, include such excavation under the item of Regular Excavation.

If the proposal shows Lateral Ditch Excavation as a separate item of payment, but does not show Channel Excavation as a separate item of payment, include such excavation under the item of Lateral Ditch Excavation. Otherwise, include Channel Excavation under the item of Regular Excavation.

120-2.2 Regular Excavation: Regular Excavation includes roadway excavation and borrow excavation, as defined below for each.

120-2.2.1 Roadway Excavation: Roadway Excavation consists of the excavation and the utilization or disposal of all materials necessary for the construction of the roadway, ditches, channel changes, etc., except as may be specifically shown to be paid for separately and that portion of the lateral ditches within the limits of the roadway right-of-way as shown in the plans.

120-2.2.2 Borrow Excavation: Borrow Excavation consists of the excavation and utilization of material from authorized borrow pits, including only material that is suitable for the construction of roadway embankments or of other embankments covered by the Contract.

A Value Engineering Change Proposal (VECP) submittal based on using borrow material from within the project limits will not be considered.

120-2.3 Subsoil Excavation: Subsoil Excavation consists of the excavation and disposal of muck, clay, rock, or any other material that is unsuitable in its original position and that is excavated below the finished grading template. For stabilized bases and sand bituminous road mixes, consider the finished grading template as the top of the finished base, shoulders and slopes. For all other bases and rigid pavement, consider the finished grading template as the finished shoulder and slope lines and bottom of completed base or rigid pavement. For pond and ditches that identify the placement of a blanket material, consider the finished grading template as the bottom of the blanket material. Subsoil Excavation also consists of the excavation of all suitable material within the above limits as necessary to excavate the unsuitable material. Consider the limits of Subsoil Excavation indicated on the plans as being particularly variable, in accordance with the field conditions actually encountered.

The quantity of material required to replace the excavated material and to raise the elevation of the roadway to the bottom of the template will be paid for under Embankment or Borrow Excavation (Truck Measure).

120-2.4 Lateral Ditch Excavation: Lateral Ditch Excavation consists of all excavation of inlet and outlet ditches to structures and roadway, changes in channels of streams, and ditches parallel to the roadway right-of-way. Dress lateral ditches to the grade and cross-section shown in the plans.

120-2.5 Channel Excavation: Channel Excavation consists of the excavation and satisfactory disposal of all materials from the limits of the channel as shown in the plans.

120-3 Preliminary Soils Investigations.

When the plans contain the results of a soil survey, do not assume such data is a guarantee of the depth, extent, or character of material present.

120-4 Removal of Unsuitable Materials and Existing Roads.

120-4.1 Subsoil Excavation: Where muck, rock, clay, or other material within the limits of the roadway is unsuitable in its original position, excavate such material to the cross-sections shown in the plans or indicated by the Engineer, and backfill with suitable material. Shape backfill material to the required cross-sections. Where the removal of plastic soils below the finished earthwork grade is required, meet a construction tolerance, from the lines shown in the plans as the removal limits, of ± 0.2 feet in depth and ± 6 inches (each side) in width.

120-4.2 Construction over Existing Old Road: Where a new roadway is to be constructed over an old one, plow or scarify the old road, and break it up full width, regardless of height of fill. If the plans provide that paving materials may be incorporated into the fill, distribute such material in a manner so as not to create voids. Recompact the old road meeting the requirements of 120-10.2.

120-4.3 Obliterating Old Road: Where the plans call for obliteration of portions of an old road outside of the proposed new roadway, obliterate such sections of the old road by grading to fill ditches and to restore approximately the original contour of the ground or a contour which produces a pleasing appearance.

120-5 Disposal of Surplus and Unsuitable Material.

120-5.1 Ownership of Excavated Materials: Dispose of surplus and excavated materials as shown in the plans or, if the plans do not indicate the method of disposal, take ownership of the materials and dispose of them outside the right-of-way.

120-5.2 Disposal of Muck on Side Slopes: As an exception to the provisions of 120-5. 1, when approved by the Engineer, in rural undeveloped areas, the Contractor may place muck (A-8 material) on the slopes, or store it alongside the roadway, provided there is a clear distance of at least 6 feet between the roadway grading limits and the muck, and the Contractor dresses the muck to present a neat appearance. In addition, the Contractor may also dispose of this material by placing it on the slopes in developed areas where, in the opinion of the Engineer, this will result in an aesthetically pleasing appearance and will have no detrimental effect on the adjacent developments. Where the Engineer permits the disposal of muck or other unsuitable material inside the right-of-way limits, do not place

such material in a manner which will impede the inflow or outfall of any channel or side ditches. The Engineer will determine the limits adjacent to channels within which such materials may be disposed.

120-5.3 Disposal of Paving Materials: Unless otherwise noted, take ownership of paving materials, such as paving brick, asphalt block, concrete slab, sidewalk, curb and gutter, etc., excavated in the removal of existing pavements, and dispose of them outside the right-of-way. If the materials are to remain the property of the Department, place them in neat piles as directed. Existing limerock base that is removed may be incorporated in the stabilized portion of the subgrade. If the construction sequence will allow, incorporate all existing limerock base into the project as allowed by the Contract Documents.

120-5.4 Disposal Areas: Where the Contract Documents require disposal of excavated materials outside the right-of-way, and the disposal area is not indicated in the Contract Documents, furnish the disposal area without additional compensation.

Provide areas for disposal of removed paving materials out of sight of the project and at least 300 feet from the nearest roadway right-of-way line of any State-maintained road. If the materials are buried, disregard the 300 foot limitation.

120-6 Borrow.

120-6.1 Materials for Borrow: Do not open borrow pits until the Engineer has approved their location. Do not provide borrow materials that are polluted as defined in Chapter 376 of the Florida Statutes (oil of any kind and in any form, gasoline, pesticides, ammonia, chlorine, and derivatives thereof, excluding liquefied petroleum gas) in concentrations above any local, State, or Federal standards.

Prior to placing any borrow material that is the product of soil incineration, provide the Engineer with a copy of the Certificate of Materials Recycling and Post Burn Analysis showing that the material is below all allowable pollutant concentrations.

120-6.2 Furnishing of Borrow Areas: To obtain the Engineer's approval to use an off-site construction activity area that involves excavation such as a borrow pit or local aggregate pit, request in writing, a Cultural Resources Assessment. Send the request to the Division of Historical Resources, Department of State, State Historic Preservation Officer, Tallahassee, FL. As a minimum, include in the request the Project Identification Number, the County, a description of the property with Township, Range, Section, etc., the dimensions of the area to be affected, and a location map. Do not start any work at the off-site construction activity area prior to receiving a clearance letter from the Division of Archives and written clearance from the Engineer concerning compliance with the Federal Endangered Species Act as specified in 7-1.4.

For certain locations, the Division of Archives will require a Cultural Resources Field Survey before approval can be granted. When this is required, secure professional archaeological services to make the survey and prepare a report. Submit the report to the Division of Archives with a copy to the Department. The Engineer will base final approval or rejection of the use of the off-site construction activity area on the report.

Before receiving approval or before use of borrow areas, obtain written clearance from the engineer concerning compliance with the Federal Endangered Species Act as specified in 7-1.4 and Section 4(f) of the USDOT Act as specified in 7-1.8.

The Department will adjust Contract Time in accordance with 8-7 for any suspension of operations required to comply with this Article. The Department will not accept any monetary claims due to delays or loss of off-site construction activity areas.

Except where the plans specifically call for the use of a particular borrow or dredging area, the Contractor may substitute borrow or dredging areas of his own choosing provided: (1) the Engineer determines the materials from such areas meet the Department's standards and other requirements for stability for use in the particular sections of the work in which it is to be placed, and (2) the Contractor absorbs any increase in hauling or other costs.

Before using any borrow material from any substitute areas, obtain the Engineer's approval, in writing, for the use of the particular areas, and, where applicable, ensure that the Engineer has cross-sectioned the surface. Upon such written approval by the Engineer, consider the substitute areas as designated borrow areas.

When furnishing the dredging or borrow areas, supply the Department with evidence that the necessary permits, rights, or waivers for the use of such areas have been secured.

Do not excavate any part of a Contractor furnished borrow area which is less than 300 feet from the right-of-way of the project or any State Road until the Engineer has approved a plan for landscaping and restoring the disturbed area. Perform this landscaping and land restoration at no expense to the Department, prior to final acceptance of the project. Do not provide a borrow area closer than 25 feet to the right-of-way of any state road. In Department furnished borrow pits, do not excavate material within 5 feet of adjacent property lines.

Upon completion of excavation, neatly shape, dress, grass, vegetate, landscape, and drain all exposed areas including haul roads, as necessary so as not to present an objectionable appearance.

Meet the requirements of Section 104 when furnishing borrow areas, regardless of location.

120-6.3 Borrow Material for Shoulder Build-up: When so indicated in the plans, furnish borrow material with a specific minimum bearing value, for building up of existing shoulders. Blend materials as necessary to achieve this specified minimum bearing value prior to placing the materials on the shoulders. Take samples of this borrow material at the pit or blended stockpile. Include all costs of providing a material with the required bearing value in the Contract unit price for borrow material.

120-6.4 Haul Routes for Borrow Pits: Provide and maintain, at no expense to the Department, all necessary roads for hauling the borrow material. Where borrow area haul roads or trails are used by others, do not cause such roads or trails to deteriorate in condition.

Arrange for the use of all non-public haul routes crossing the property of any railroad. Incur any expense for the use of such haul routes. Establish haul routes which will direct construction vehicles away from developed areas when feasible, and keep noise from hauling operations to a minimum. Advise the Engineer in writing of all proposed haul routes.

120-6.5 Authorization for Use of Borrow: When the item of Borrow Excavation is included in the Contract, use borrow only when sufficient quantities of suitable material are not available from roadway and drainage excavation, to properly construct the embankment, subgrade, and shoulders, and to

complete the backfilling of structures. Do not use borrow material until so ordered by the Engineer, and then only use material from approved borrow pits.

120-7 Materials for Embankment.

120-7.1 Use of Materials Excavated From the Roadway and Appurtenances: Assume responsibility for determining the suitability of excavated material for use on the project in accordance with the applicable Contract Documents. Consider the sequence of work and maintenance of traffic phasing in the determination of the availability of this material.

120-7.2 General Requirements for Embankment Materials: Construct embankments of acceptable material including reclaimed asphalt pavement (RAP), reclaimed concrete aggregate (RCA) and portland cement concrete rubble, but containing no muck, stumps, roots, brush, vegetable matter, rubbish, reinforcement bar or other material that does not compact into a suitable and enduring roadbed. Do not use RAP or RCA in the top 3 feet of slopes and shoulders that are to be grassed or have other type of vegetation established.

Remove all waste material designated as undesirable. Use material in embankment construction in accordance with plan details or as the Engineer directs.

Complete the embankment using maximum particle sizes (in any dimension) as follows:

In top 12 inches: 3 1/2 inches (in any dimension).

12 to 24 inches: 6 inches (in any dimension).

In the depth below 24 inches: not to exceed 12 inches (in any dimension) or the compacted thickness of the layer being placed, whichever is less.

Spread all material so that the larger particles are separated from each other to minimize voids between them during compaction. Compact around these rocks in accordance with 120-9.2.

When and where approved by the Engineer, the Contractor may place larger rocks (not to exceed 18 inches in any dimension) outside the one to two slope and at least 4 feet or more below the bottom of the base. Compact around these rocks to a firmness equal to that of the supporting soil. Construct grassed embankment areas in accordance with 120-9.2.6. Where constructing embankments adjacent to bridge end bents or abutments, do not place rock larger than 3 1/2 inches in diameter within 3 feet of the location of any end-bent piling.

120-7.3 Materials Used at Pipes, Culverts, etc.: Construct embankments over and around pipes, culverts, and bridge foundations with selected materials.

120-8 Embankment Construction.

120-8.1 General: Construct embankments in sections of not less than 300 feet in length or for the full length of the embankment. Perform work in accordance with an approved Quality Control Plan meeting the requirements of 105-3.

For construction of mainline pavement lanes, turn lanes, ramps, parking lots, concrete box culverts and retaining wall systems, a LOT is defined as a single lift of finished embankment not to exceed 500 feet.

For construction of shoulder-only areas, bike/shared use paths, and sidewalks areas, a LOT is defined as 2,000 feet or one Day's Production, whichever is greater.

Isolated compaction operations will be considered as separate LOTS. For multiple phase construction, a LOT shall not extend beyond the limits of the phase.

120-8.2 Dry Fill Method:

120-8.2.1 General: Construct embankments to meet compaction requirements in Article 120-9 and in accordance with the acceptance program requirements in 120-10. Restrict the compacted thickness of the last embankment lift to 6 inches maximum.

120-8.2.1.1 For A-3, and A-2-4 Materials with up to 15% fines: Construct the embankment in successive layers with lifts up to a maximum compacted thickness of 12 inches. Ensure the percentage of fines passing the No. 200 US Standard sieve in the A-2-4 material does not exceed 15%.

120-8.2.1.2 For A-1, Plastic materials (As designated in Design Standard Index 505) and A-2-4 Materials with greater than 15% fines: Construct the embankment in successive layers with lifts up to a maximum compacted thickness of 6 inches.

Alternately, for A-1, Plastic material and A-2-4 Materials with greater than 15% fines, construct embankments using thick lift construction in successive layers of not more than 12 inches compacted thickness, after having demonstrated with a successful test section, the possession and control of compacting equipment sufficient to achieve density required by 120-10.2 for the full depth of a thicker lift, and if the Engineer approves the compaction effort. Notify the Engineer prior to beginning construction of a test section. Construct a test section of the length of one full LOT. Perform five QC tests at random locations within the test section. All five QC tests and a Department Verification test must meet the density required by 120-10.2. Identify the test section with the compaction effort and soil classification in the Density Log Book. In case of a change in compaction effort or soil classification, failing QC test or when the QC tests cannot be verified, construct a new test section. The Contractor may elect to place material in 6 inches compacted thickness at any time. Construct all layers approximately parallel to the centerline profile of the road.

The Engineer reserves the right to terminate the Contractor's use of thick lift construction. Whenever the Engineer determines that the Contractor is not achieving satisfactory results, revert to the 6 inch compacted lifts.

As far as practicable, distribute traffic over the work during the construction of embankments so as to cover the maximum area of the surface of each layer.

Construct embankment in the dry whenever normal dewatering equipment and methods can accomplish the needed dewatering.

120-8.2.1.3 Equipment and Methods: Provide normal dewatering equipment including, but not limited to, surface pumps, sump pumps and trenching/digging machinery. Provide normal dewatering methods including, but not limited to, constructing shallow surface drainage trenches/ditches, using sand blankets, sumps and siphons.

When normal dewatering does not adequately remove the water, the Engineer may require the embankment material to be placed in the water or on low swampy ground in accordance with 120-9.2.3.

120-8.2.2 Placing in Unstable Areas: Where depositing the material in water, or on low swampy ground that will not support the weight of hauling equipment, construct the embankment by dumping successive loads in a uniformly distributed layer of a thickness not greater than necessary to support the hauling equipment while placing subsequent layers. Once sufficient material has been placed so that the hauling equipment can be supported, construct the remaining portion of the embankment in layers in accordance with the applicable provisions of 120-9.2.2 and 120-9.2.4.

120-8.2.3 Placing on Steep Slopes: When constructing an embankment on a hillside sloping more than 20 degrees from the horizontal, before starting the fill, deeply plow or cut into steps the surface of the original ground on which the embankment is to be placed.

120-8.2.4 Placing Outside Standard Minimum Slope: Where material that is unsuitable for normal embankment construction is to be used in the embankment outside the standard minimum slope (approximately one to two), place such material in layers of not more than 18 inches in thickness, measured loose. The Contractor may also place material which is suitable for normal embankment, outside such standard minimum slope, in 18 inch layers. Maintain a constant thickness for suitable material placed within and outside the standard minimum slope, unless placing in a separate operation.

120-8.3 Hydraulic Method:

120-8.3.1 Method of Placing: When the hydraulic method is used, as far as practicable, place all dredged material in its final position in the embankment by such method. Place and compact any dredged material that is rehandled, or moved and placed in its final position by any other method, as specified in 120-9.2. The Contractor may use baffles or any form of construction he may select provided the slopes of the embankments are not steeper than indicated in the plans. Remove all timber used for temporary bulkheads or baffles from the embankment, and fill and thoroughly compact the holes thus formed. When placing fill on

submerged land, construct dikes prior to beginning of dredging, and maintain the dikes throughout the dredging operation.

120-8.3.2 Excess Material: Do not use excess material placed outside the prescribed slopes, below the normal high-water level, to raise the fill. Remove only the portion of this material required for dressing the slopes.

120-8.3.3 Protection of Openings in Embankment: Leave openings in the embankments at the bridge sites. Remove any material which invades these openings or existing channels without additional compensation to provide the same depth of channel as existed before the construction of the embankment. Do not excavate or dredge any material within 200 feet of the toe of the proposed embankment.

120-8.4 Reclaimed Asphalt Pavement (RAP) Method:

120-8.4.1 General: Use only RAP material: 1) stored at facilities with an approved Florida Department of Environmental Protection Stormwater permit; or, 2) transferred directly from a milling project to the Department project. Certify the source if RAP material is from an identifiable Department project. Do not use RAP material in the following areas: 1) Construction areas that are below the seasonal high groundwater table elevation; or 2) MSE Wall backfill.

Prior to placement, submit documentation to the Engineer for his approval, outlining the proposed location of the RAP material.

120-8.4.2 Soil and RAP Mixture: Place the RAP material at the location and spread uniformly, using approved methods to obtain a maximum layer thickness of 4 inches. Mix this 4 inches maximum layer of RAP with a loose soil layer of 8 to 10 inches thickness. After mixing, meet all Embankment Utilization requirements of Index 505 for the location used. Do not mix RAP in the uppermost 12 inches in order to comply with 120-8.2.1. The total RAP and other embankment material shall not exceed 12 inches per lift after mixing and compaction if the contractor can demonstrate that the density of the mixture can be achieved. Perform mixing using rotary tillers or other equipment meeting the approval of the Engineer. The Engineer will determine the order in which to spread the two materials. Mix both materials to the full depth. Ensure that the finished layer will have the thickness and shape required by the typical section. Demonstrate the feasibility of this construction method by successfully completing a 500-foot-long test section. For embankment construction, meet the requirements of 120-8. For compaction requirements of the soil and RAP mixture, meet the requirements of 120-9.

120-8.4.3 Alternate Soil and RAP Layer Construction: As an alternate to 120-8.4.2, construct soil and RAP in alternate layers. Use soil with a minimum LBR value of 40 to prevent failure during compaction of the overlying RAP layer. Alternate compacted lifts of RAP layer and soil layer, each with a six-inch-maximum thickness. Demonstrate this construction method by successfully completing a 500-foot-long test section. For compaction requirements of both soil and RAP, meet the requirements of 120-9.120-9 Compaction Requirements.

120-9 Compaction Requirements.

120-9.1 Moisture Content: Compact the materials at a moisture content such that the specified density can be attained. If necessary to attain the specified density, add water to the material, or lower the moisture content by manipulating the material or allowing it to dry, as is appropriate.

120-9.2 Compaction of Embankments:

120-9.2.1 General: Uniformly compact each layer, using equipment that will achieve the required density, and as compaction operations progress, shape and manipulate each layer as necessary to ensure uniform density throughout the embankment.

120-9.2.2 Compaction Over Unstable Foundations: Where the embankment material is deposited in water or on low swampy ground, and in a layer thicker than 12 inches (as provided in 120-8.2.2), compact the top 6 inches (compacted thickness) of such layer to the density as specified in 120-10.2.

120-9.2.3 Compaction Where Plastic Material Has Been Removed: Where unsuitable material is removed and the remaining surface is of the A-4, A-5, A-6, or A-7 Soil Groups (see AASHTO M-145), as determined by the Engineer, compact the surface of the excavated area by rolling with a sheepsfoot roller exerting a compression of at least 250 psi on the tamper feet, for the full width of the roadbed (subgrade and shoulders). Perform rolling before beginning any backfill, and continue until the roller feet do not penetrate the surface more than 1 inch. Do not perform such rolling where the remaining surface is below the normal water table and covered with water. Vary the procedure and equipment required for this operation at the discretion of the Engineer.

120-9.2.4 Compaction of Material To Be Used In Base, Pavement, or Stabilized Areas: Do not compact embankment material which will be incorporated into a pavement, base course, or stabilized subgrade, to be constructed as a part of the same Contract.

120-9.2.5 Compaction of Grassed Shoulder Areas: For the upper 6-inch layer of all shoulders which are to be grassed, since no specific density is required, compact only to the extent directed.

120-9.2.6 Compaction of Grassed Embankment Areas: For the outer layer of all embankments where plant growth will be established, do not compact. Leave this layer in a loose condition to a minimum depth of 6 inches for the subsequent seeding or planting operations.

120-9.3 Compaction for Pipes, Culverts, etc.: Compact the backfill of trenches to the densities specified for embankment or subgrade, as applicable, and in accordance with the requirements of 125-9.2.

Thoroughly compact embankments over and around pipes, culverts, and bridges in a manner which will not place undue stress on the structures, and in accordance with the requirements of 125-9.2.

120-9.4 Compaction of Subgrade: If the plans do not provide for stabilizing, compact the subgrade (as defined in 1-3) in both cuts and fills, to the density specified in 120-10.2. For undisturbed soils, do not apply density requirements where constructing narrow widening strips or paved shoulders 5 feet or less in width.

Where trenches for widening strips are not of sufficient width to permit the use of standard compaction equipment, perform compaction using vibratory rollers, trench rollers, or other type compaction equipment approved by the Engineer.

Maintain the required density until the base or pavement is placed on the subgrade.

120-10 Acceptance Program.

120-10.1 General Requirements: 120-10.1.1 Initial Equipment Comparison: Before initial production, perform a comparison test using the Quality Control, Verifications and Independent Assurance gauges. Unless the Engineer instructs, do not perform the initial equipment comparison more than once per project. When comparing the computed dry density of one nuclear gauge to a second gauge, ensure that the difference between the two computed dry densities does not exceed 2 lb/ft³ between gauges from the same manufacturer, and 3 lb/ft³ between gauges from different manufacturers. Repair or replace any Quality Control gauge that does not compare favorably with the IA gauge.

Perform a comparison analysis between the Quality Control nuclear gauge and the Verification nuclear gauge any time a nuclear gauge or repaired nuclear gauge is first brought to the project. Repair and replace any Quality Control gauge that does not compare favorably with the Verification gauge at any time during the remainder of the project. Calibrate all Quality Control gauges annually.

120-10.1.2 Initial Production Lot: Before construction of any other LOT, prepare a 500-foot initial control section consisting of one full LOT in accordance with the approved Quality Control Plan for the project. Notify the Engineer at least 24 hours prior to production of the initial control section. Perform all QC tests required in 120-10.1.4. When the initial Quality Control test results pass specifications, the Engineer will perform a Verification test to verify compliance with the specifications. Do not begin constructing another LOT until successfully completing the initial production LOT. The Engineer will notify the Contractor of the initial production lot approval within three working days after receiving the Contractor's Quality Control data when test results meet the following conditions:

Quality Control tests must meet the specifications.

Verification test must meet the specifications.

Difference between Quality Control and Verification computed Dry Density results shall meet the requirements of 120-10.1.1.

If Verification test result fails the density requirements of 120-10.2, correct the areas of non-compliance. The Quality Control and Verification tests will then be repeated. The Engineer will reject the Contractor's Quality Control Plan after three unsuccessful Verification attempts. Submit a revised Quality Control Plan to the Engineer for approval.

120-10.1.3 Density over 105%: When a QC computed dry density results in a value greater than 105% of the applicable Proctor maximum dry density, the Engineer will perform an Independent Verification density test within 5 feet. If the Independent Verification density results in a value greater than 105%, the Engineer will investigate the compaction methods, examine the applicable Standard Proctor Maximum Density and material description. The Engineer may collect and test an Independent Verification Standard Proctor Maximum Density sample for acceptance in accordance with the criteria of 120-10.2.

120-10.1.4 Quality Control Tests:

120-10.1.4.1 Standard Proctor Maximum Density Determination: Determine the Quality Control standard Proctor maximum density and optimum moisture content by sampling and testing the material in accordance with the specified test method listed in 120-10.2.

120-10.1.4.2 Density Testing Requirements: Ensure compliance to the requirements of 120-10.2 by Nuclear Density testing in accordance with FM 1-T 238. Determine the in-place moisture content for each density test. Use Florida Method FM 1-T 238, FM 5-507 (Determination of Moisture Content by Means of a Calcium Carbide Gas Pressure Moisture Tester), or ASTM D-4643 (Laboratory Determination of Moisture Content of Granular Soils By Use of a Microwave Oven) for moisture determination.

120-10.1.4.3 Soil Classification: Perform soil classification tests on the sample collected in 120-10.1.4.1, in accordance with AASHTO T-88. Classify soils in accordance with AASHTO M-145 in order to determine compliance with embankment utilization requirements. Unless required by the Engineer, do not test or classify materials for stabilized subgrade or base.

120-10.1.5 Department Verification: The Engineer will conduct a Verification test(s) in order to accept all materials and work associated with 120-10.1.4. The Engineer will verify the Quality Control results if they meet the Verification Comparison Criteria, otherwise the Engineer will implement Resolution procedures.

The Engineer will select test locations, including Station, Offset, and Lift, using a Random Number generator based on the Lots under consideration. Each Verification test evaluates all work represented by the Quality Control testing completed in those LOTS.

In addition to the Verification testing, the Engineer may perform additional Independent Verification (IV) testing. The Engineer will evaluate and act upon the IV test results in the same manner as Verification test results.

When the project requires less than four Quality Control tests per material type, the Engineer reserves the right to accept the materials and work through visual inspection.

120-10.1.6 Reduced Testing Frequency: When no Resolution testing is required for 12 consecutive verified LOTS, or if required, the QC test data was upheld, reduce the QC density testing to one test every two LOTS by identifying the substantiating tests in the Density Log Book and notifying the Engineer in writing prior to starting reduced frequency of testing. Generate random numbers based on the two LOTS under consideration. When Quality Control test frequency is reduced to one every two LOTS, obtain the Engineer's approval to place more than one LOT over an untested LOT. Assure similar compaction efforts for the untested LOTS. If the Verification test fails, and Quality Control test data is not upheld by Resolution testing, the Quality Control testing will revert to the original frequency of one Quality Control test per LOT. Do not apply reduced testing frequency in construction of shoulder-only areas, bike/shared use paths and sidewalks.

120-10.2 Acceptance Criteria: Obtain a minimum Quality Control (QC) density of 100% of the standard Proctor maximum density as determined by AASHTO T-99, Method C, with the following exceptions: 1) embankment constructed by the hydraulic method as specified in 120-8.3; 2) material placed outside the standard minimum slope as specified in 120-8.2.4; and 3) other areas specifically excluded herein.

120-10.3 Additional Requirements:

120-10.3.1 Frequency: Conduct QC sampling and testing at a minimum frequency listed in the table below. The Engineer will perform Verification sampling and tests at a minimum frequency listed in the table below.

Test Name	Quality Control	Verification	Verification of Shoulder-Only Areas, Bike/Shared Use Paths, and Sidewalks
Standard Proctor Maximum Density	One per soil type	One per soil type	One per soil type
Density	One per LOT	One per four LOTs and for wet conditions, the first lift not affected by water	One per two LOTs
Soil Classification	One per Standard Proctor Maximum Density	One per Standard Proctor Maximum Density	One per Standard Proctor Maximum Density

120-10.3.2 Test Selection and Reporting: Determine test locations including Stations and offsets, using the random number generator approved by the Engineer. Do not use note pads or work sheets to record data for later transfer to the Density Log Book. Notify the Engineer upon successful completion of Quality Control testing on each LOT.

120-10.4 Verification Comparison Criteria and Resolution Procedures:

120-10.4.1 Standard Proctor Maximum Density Determination: The Engineer will verify the Quality Control results if the results compare within 4.5 lb/ft³ of the Verification test result. Otherwise, the Engineer will take one additional sample of material from the soil type in question. The State Materials Office or an AASHTO accredited laboratory designated by the State Materials Office will perform Resolution testing. The material will be sampled and tested in accordance with AASHTO T-99, Method C.

The Engineer will compare the Resolution Test results with the Quality Control test results. If all Resolution Test results are within 4.5 lb/ft³ of the corresponding Quality Control test results, the Engineer will use the Quality Control test results for material acceptance purposes for each LOT with that soil type. If the Resolution Test result is not within 4.5 lb/ft³ of the Contractor's Quality Control test, the Verification Test result will be used for material acceptance purposes.

120-10.4.2 Density Testing: When a Verification or Independent Verification density test fails the Acceptance Criteria, retest the site within a 5 feet radius and the following actions will be taken:

1. If the Quality Control retest meets the Acceptance Criteria and meets the 120-10.1.1 criteria when compared with the Verification or Independent Verification test, the Engineer will accept those LOTs.

2. If the Quality Control retest does not meet the Acceptance Criteria and compares favorably with the Verification or Independent Verification test, rework and retest the LOT. The Engineer will re-verify those LOTs.
3. If the Quality Control retest and the Verification or Independent Verification test do not compare favorably, complete a new comparison analysis as defined in 120-10.1.1. Once acceptable comparison is achieved, retest the LOTs. The Engineer will perform new verification testing. Acceptance testing will not begin on a new LOT until the Contractor has a gauge that meets the comparison requirements.

Record Quality Control test results in the density log book on approved Department forms provided by the Engineer. Submit the original, completed density log book to the Engineer at final acceptance.

120-10.4.3 Soil Classification: The Engineer will verify the Quality Control results if the Verification results identify matching soil classifications. Otherwise, the Engineer will take one additional sample of material from the soil type in question. The State Materials Office or an AASHTO accredited laboratory designated by the State Materials Office will perform Resolution testing. The material will be sampled and tested in accordance with AASHTO T-88.

The Engineer will compare the Resolution Test results with the Quality Control test results. If the Resolution test matches the Quality Control classification, the Engineer will use the Quality Control classification for material acceptance purposes. If the Resolution Test result does not match the Contractor's Quality Control classification, the Verification Test result will be used for material acceptance purposes.

120-11 Maintenance and Protection of Work.

While construction is in progress, maintain adequate drainage for the roadbed at all times. Maintain a shoulder at least 3 feet wide adjacent to all pavement or base construction in order to provide support for the edges.

Maintain all earthwork construction throughout the life of the Contract, and take all reasonable precautions to prevent loss of material from the roadway due to the action of wind or water. Repair, at no expense to the Department, except as otherwise provided herein, any slides, washouts, settlement, subsidence, or other mishap which may occur prior to final acceptance of the work. Perform maintenance and protection of earthwork construction in accordance with Section 104.

Maintain all channels excavated as a part of the Contract work against natural shoaling or other encroachments to the lines, grades, and cross-sections shown in the plans, until final acceptance of the project.

120-12 Construction.

120-12.1 Construction Tolerances: Shape the surface of the earthwork to conform to the lines, grades, and cross-sections shown in the plans. In final shaping of the surface of earthwork, maintain a tolerance of 0.3 foot above or below the plan cross-section with the following exceptions:

1. Shape the surface of shoulders to within 0.1 foot of the plan cross-section.

2. Shape the earthwork to match adjacent pavement, curb, sidewalk, structures, etc.
3. Shape the bottom of ditches so that the ditch impounds no water.
4. When the work does not include construction of base or pavement, shape the entire roadbed (shoulder point to shoulder point) to within 0.1 foot above or below the plan cross-section.

Ensure that the shoulder lines do not vary horizontally more than 0.3 foot from the true lines shown in the plans.

120-12.2 Operations Adjacent to Pavement: Carefully dress areas adjacent to pavement areas to avoid damage to such pavement. Complete grassing of shoulder areas prior to placing the final wearing course. Do not manipulate any embankment material on a pavement surface.

When shoulder dressing is underway adjacent to a pavement lane being used to maintain traffic, exercise extreme care to avoid interference with the safe movement of traffic.

120-13 Method of Measurement.

120-13.1 General: When payment for excavation is on a volumetric basis, the quantity to be paid for will be the volume, in cubic yards, calculated by the method of average end areas, unless the Engineer determines that another method of calculation will provide a more accurate result. The material will be measured in its original position by field survey or by photogrammetric means as designated by the Engineer, unless otherwise specified under the provisions for individual items.

Where Subsoil Excavation extends outside the lines shown in the plans or authorized by the Engineer including allowable tolerances, and the space is backfilled with material obtained in additional authorized roadway or borrow excavation, the net fill, plus shrinkage allowance, will be deducted from the quantity of Roadway Excavation or Borrow Excavation to be paid for, as applicable.

The quantity of all material washed, blown, or placed beyond the authorized roadway cross-section will be determined by the Engineer and will be deducted from the quantity of Roadway Excavation or Borrow Excavation to be paid for, as applicable.

Subsoil Excavation that extends outside the lines shown in the plans or authorized by the Engineer including allowable tolerances will be deducted from the quantity to be paid for as Subsoil Excavation.

120-13.2 Roadway Excavation: The measurement will include only the net volume of material excavated between the original ground surface and the surface of the completed earthwork, except that the measurement will also include all unavoidable slides which may occur in connection with excavation classified as Roadway Excavation.

The pay quantity will be the plan quantity provided that the excavation was accomplished in substantial compliance with the plan dimensions and subject to the provisions of 9-3.2 and 9-3.4. On designated 3-R Projects, Regular Excavation will be paid for at the Contract lump sum price provided that the excavation was accomplished in substantial compliance with the plan dimension.

120-13.3 Borrow Excavation: Measurement will be made on a loose volume basis, as measured in trucks or other hauling equipment at the point of dumping on the road. If measurement is made in vehicles, level the material to facilitate accurate measurement.

Unsuitable material excavated from borrow pits where truck measurement is provided for and from any borrow pits furnished by the Contractor, will not be included in the quantity of excavation to be paid for.

120-13.4 Lateral Ditch Excavation: The measurement will include only material excavated within the lines and grades indicated in the plans or as directed by the Engineer. The measurement will include the full station-to-station length shown in the plans or directed by the Engineer and acceptably completed. Excavation included for payment under Section 125 will not be included in this measurement.

The pay quantity will be the plan quantity provided that the excavation was accomplished in substantial compliance with the plan dimensions and subject to the provisions of 9-3.2 and 9-3.4.

120-13.5 Channel Excavation: The measurement will include only material excavated within the lines and grades indicated in the plans or in accordance with authorized plan changes.

The measurement will include the full station-to-station length shown in the plans including any authorized changes thereto.

If shoaling occurs subsequent to excavation of a channel and the Engineer authorized the shoaled material to remain in place, the volume of any such material remaining within the limits of channel excavation shown in the plans will be deducted from the measured quantity of Channel Excavation.

120-13.6 Subsoil Excavation: The measurement will include only material excavated within the lines and grades indicated in the plans (including the tolerance permitted therefore) or as directed by the Engineer.

When no item for Subsoil Excavation is shown in the proposal but Subsoil Excavation is subsequently determined to be necessary, such unanticipated Subsoil Excavation will be paid for as provided in 4-4.

120-13.7 Embankment: The quantity will be at the plan quantity.

Where payment for embankment is not to be included in the payment for the excavation, and is to be paid for on a cubic yard basis for the item of Embankment, the plan quantities to be paid for will be calculated by the method of average end areas unless the Engineer determines that another method of calculation will provide a more accurate result. The measurement will include only material actually placed above the original ground line, within the lines and grades indicated in the plans or directed by the Engineer. The length used in the computations will be the station-to-station length actually constructed. The original ground line used in the computations will be as determined prior to placing of embankment subject to the provisions of 9-3.2, and no allowance will be made for subsidence of material below the surface of the original ground.

If there are authorized changes in plan dimensions or if errors in plan quantities are detected, plan quantity will be adjusted as provided in 9-3.2.

Where the work includes excavation of unsuitable material below the finished grading template or original ground line, whichever is lower as defined in 120-3.3, the original ground line is defined as the surface prior to beginning excavation, except that this surface is not outside the permissible tolerance of

lines and grades for Subsoil Excavation as indicated in the plans or as directed by the Engineer. Any overrun or underrun of plan quantity for Subsoil Excavation which results in a corresponding increase or decrease in embankment will be considered as an authorized plan change for adjustment purposes as defined in 9-3.2.2.

No payment will be made for embankment material used to replace unsuitable material excavated beyond the lines and grades shown in the plans or ordered by the Engineer.

In no case will payment be made for material allowed to run out of the embankment on a flatter slope than indicated on the cross-section. The Contractor shall make his own estimate on the volume of material actually required to obtain the pay section.

120-14 Basis of Payment.

120-14.1 General: Prices and payments for the various work items included in this Section will be full compensation for all work described herein, including excavating, dredging, hauling, placing, and compacting; dressing the surface of the earthwork; maintaining and protecting the complete earthwork; and hauling.

The Department will not allow extra compensation for any rehandling of materials.

The Department will compensate for the cost of grassing or other permanent erosion control measures directed by the Engineer as provided in the Contract for similar items of roadway work.

120-14.2 Excavation:

120-14.2.1 Items of Payment: When no classification of material is indicated in the plans, and bids are taken only on Regular Excavation, the total quantity of all excavation specified under this Section will be paid for at the Contract unit price for Regular Excavation.

When separate classifications of excavation are shown in the proposal, the quantities of each of the various classes of materials so shown will be paid for at the Contract unit prices per cubic yard for Regular Excavation, Lateral Ditch Excavation, Subsoil Excavation, and Channel Excavation, as applicable, and any of such classifications not so shown will be included under the item of Regular Excavation (except that if there is a classification for Lateral Ditch Excavation shown and there is no classification for Channel Excavation, any channel excavation will be included under the item of Lateral Ditch Excavation). As an exception, on designated Projects, Regular Excavation will be paid for at the Contract lump sum price.

120-14.2.2 Basic Work Included in Payments: Prices and payments will be full compensation for all work described under this Section, except for any excavation, or embankment which is specified to be included for payment under other items. Such prices and payments will include hauling; any rehandling that may be necessary to accomplish final disposal as shown in the plans; the dressing of shoulders, ditches and slopes; removal of trash, vegetation, etc., from the previously graded roadway where no item for clearing and grubbing is shown in the plans; and compacting as required.

120-14.2.3 Additional Depth of Subsoil Excavation: Where Subsoil Excavation is made to a depth of 0 to 5 feet below the depth shown on the Contract plans, such excavation will be paid for at the unit price bid.

Where Subsoil Excavation is made to a depth greater than 5 feet, and up to 15 feet, deeper than the depth shown on the Contract plans, such excavation will be paid for at the unit price bid plus 25% of such unit price. Additional extra depth, more than 15 feet below such plan depth, will be considered as a change in the character of the work and will be paid for as Unforeseeable Work.

Where no subsoil excavation is shown in a particular location on the original plans, payment for extra depth of subsoil will begin 5 feet below the lowest elevation on the grading template.

120-14.2.4 Borrow Excavation: When the item of Borrow Excavation is included in the Contract, price and payment will also include the cost of furnishing the borrow areas and any necessary clearing and grubbing thereof, the removal of unsuitable material that it is necessary to excavate in order to obtain suitable borrow material, and also the costs incurred in complying with the provisions of 120-6.3.

120-14.2.5 Materials Excluded from Payment for the Excavation: No payment as excavation will be made for any excavation covered for payment under the item of Embankment.

No payment will be made for the excavation of any materials which are used for purposes other than those shown in the plans or designated by the Engineer. No payment will be made for materials excavated outside the lines and grades given by the Engineer, unless specifically authorized by the Engineer; except that, in the operations of roadway excavation, all slides and falls of insecure masses of material beyond the regular slopes

and not due to lack of precaution on the part of the Contractor will be paid for at the Contract unit price for the material involved. The removal of slides and falls of material classified as Lateral Ditch Excavation or as Subsoil Excavation will not be paid for separately, but will be included in the Contract unit price for the pay quantity of these materials, measured as provided in 120-14.

120-14.3 Embankment:

120-14.3.1 General: Price and payment will be full compensation for all work specified in this Section, including all material for constructing the embankment; all excavating, dredging, pumping, placing and compacting of material for constructing the embankment complete; dressing of the surface of the roadway, maintenance and protection of the completed earthwork, and the removal of rubbish, vegetation, etc., from the roadway, where no clearing and grubbing of the area is specified in the plans. Also, such price and payment, in each case, will specifically include all costs of any roadway, lateral ditch, or channel excavation, unless such excavation is specifically shown to be paid for separately, regardless of whether the materials are utilized in the embankment.

120-14.3.2 Excluded Material: No payment will be made for the removal of muck or overburden from the dredging or borrow areas. No payment will be made for embankment material used to replace muck or other unsuitable material excavated beyond the lines and grades shown in the plans or ordered by the Engineer.

120-14.3.3 Clearing and Grubbing: No payment will be made for any clearing and grubbing of the borrow or dredging areas. Where no clearing and grubbing of such areas is specified in the plans, the cost of any necessary clearing and grubbing will be included in the Contract unit or lump sum price for Embankment.

120-14.3.4 Cost of Permits, Rights, and Waivers: Where the Contractor provides borrow or dredging areas of his own choosing, the cost of securing the necessary permits, rights or waivers will be included in the Contract price for Embankment.

120-14.4 Payment Items: Payment will be made under:

Item No. 120- 1- Unclassified Excavation and Embankment - per Lump Sum (LS).

SECTION 160

STABILIZING

PART 1 - DESCRIPTION

Stabilize portions of the roadbed to provide a firm and unyielding subgrade, having the required bearing value specified in the Plans.

PART 2 - MATERIALS

160-2.1 Commercial Material: Meet the requirements of FDOT Specifications Section 914.

160-2.2 Local Material: Meet the requirements of FDOT Specifications Section 914. Test material from each source, or if authorized by the Engineer, test blended materials. Submit test results to the Engineer at least 14 days prior to the stabilization operation.

160-2.3 Existing Base: When the material from an existing base is used as all, or a portion, of the stabilizing additives, no further testing is required unless directed by the Engineer.

160-2.4 Granular Subbase: The Engineer may allow, at no additional cost to the Owner, the substitution of 6 inches of Granular Subbase meeting the requirements of 290-2 and 290-3, when 12 inches of Stabilization requiring a Limerock Bearing Ratio (LBR) value of 40 is specified.

PART 3 - CONSTRUCTION METHODS

160-3.1 General: Prior to the beginning of stabilizing operations, construct the area to be stabilized to an elevation such that, upon completion of stabilizing operations, the completed stabilized subgrade will conform to the lines, grades, and cross-section shown in the Plans. Prior to spreading any additive stabilizing material, bring the surface of the roadbed to a plane approximately parallel to the plane of the proposed finished surface.

Construct pavement lanes and parking lots meeting the requirements of 120-6.1, except replace "Embankment" with "Subgrade." Construct sidewalk and bike/shared use path areas meeting the requirements of 120-6.1 except replace "Embankment" with "Subgrade" and meet the acceptance criteria of 160-4.2.

160-3.2 Application of Stabilizing Material: After substantially completing the roadbed grading operations, determine the type and quantity (if any) of stabilizing material necessary for compliance with the bearing value requirements. Notify the Engineer of the approximate quantity to be added before spreading. When additive stabilizing materials are required, spread the material uniformly over the area to be stabilized.

160-3.3 Mixing: Perform mixing using rotary tillers, a plant or other equipment meeting the approval of the Engineer. The subgrade may be mixed in one course if the equipment and method of construction provides the uniformity, particle size limitation, compaction and other desired results of 160-4. Thoroughly mix the area to be stabilized throughout the entire depth and width of the stabilizing

limits.

Perform the mixing operations, as specified, (either in place or in a plant) regardless of whether the existing soil, or any select soils placed within the limits of the stabilized sections, have the required bearing value without the addition of stabilizing materials.

160-3.4 Maximum Particle Size of Mixed Materials: At the completion of the mixing, ensure that the gradation of the material within the limits of the area being stabilized is such that 97% will pass a 3 1/2 inch sieve and that the material does not have a plasticity index greater than eight or liquid limit greater than 30. Remove any materials not meeting the plasticity requirements from the stabilized area. Break down or remove from the stabilized area materials, including clay lumps or lumps made of clay-size particles (any particle size 2 microns or less), not meeting the gradation requirements.

160-3.5 Bearing Value: Meet the bearing value requirements for the subgrade in accordance with 160-4.

160-3.6 Compaction: After completing the mixing operations and satisfying the requirements for bearing value, uniformity, and particle size. Compact the materials at a moisture content permitting the specified compaction in 160-4.2.3. If the moisture content of the material is improper for attaining the specified density, either add water or allow the material to dry until reaching the proper moisture content for the specified compaction.

160-3.7 Finish Grading: Shape the completed stabilized subgrade to conform with the finished lines, grades, and cross-section indicated in the Plans. Check the subgrade using elevation stakes or other means approved by the Engineer.

160-3.8 Requirements for Condition of Completed Subgrade: After completing the stabilizing and compacting operations, ensure that the subgrade is firm and substantially unyielding to the extent that it will support construction equipment and will have the bearing value required by the Plans.

Remove all soft and yielding material, and any other portions of the subgrade which will not compact readily, and replace it with suitable material so that the whole subgrade is brought to line and grade, with proper allowance for subsequent compaction.

160-3.9 Maintenance of Completed Subgrade: After completing the subgrade as specified above, maintain it free from ruts, depressions, and any damage resulting from the hauling or handling of materials, equipment, tools, etc. The Contractor is responsible for maintaining the required density until the subsequent base or pavement is in place including any repairs, replacement, etc., of curb and gutter, sidewalk, etc., which might become necessary in order to recompact the subgrade in the event of underwash or other damage occurring to the previously compacted subgrade. Perform any such recompaction at no expense to the Owner. Construct and maintain ditches and drains along the completed subgrade section.

PART 4 - ACCEPTANCE PROGRAM

160-4.1 General Requirements: Meet the requirements of 120-8, except 160-4.2 160-4.3, and 160-4.4 shall supersede requirements in 120-8.

160-4.2 Acceptance Criteria:

160-4.2.1 Bearing Value Requirements:

160-4.2.1.1 General: Within the entire limits of the width and depth of the areas to be stabilized, obtain the required minimum bearing value. For any area where the bearing value obtained is deficient from the value indicated in the Plans, in excess of the tolerances established herein, spread and mix additional stabilizing material in accordance with 160-3.3.

160-4.2.2 Mixing Depth Requirements: Do not exceed individual plan depth thickness by more than 2 inches or exceed LOT-average depth thickness by more than 1 inch measured to the nearest 0.25 inch. No undertolerance of mixing depth is allowed.

As an exception to the above mixing requirements, where the subgrade is of rock, the Engineer may waive the mixing operations (and the work of stabilizing), and the Owner will not pay for stabilization for such sections.

160-4.2.3 Density Requirements:

160-4.2.3.1 General: Within the entire limits of the width and depth of the areas to be stabilized, other than as provided in 160-4.2.3.2, obtain a minimum density at any location of 98% of the Modified Proctor maximum density as determined by FM 1-T 180, Method D.

160-4.2.3.2 Exceptions to Density Requirements: The Contractor need not obtain the minimum density specified in 160-4.2.3.1 if within the following limits:

(a) The width and depth of areas which are to be subsequently incorporated into a base course under the same contract.

(b) The upper 6 inches of areas to be grassed under the same contract. Compact these areas to a reasonably firm condition as directed by the Engineer.

160-4.3 Additional Requirements:

160-4.3.1 Quality Control Testing:

160-4.3.1.1 Bearing Values: Test the Stabilized Subgrade sample collected in 160-4.3.1.3. Determine the LBR in accordance with FM 5-515 and 160-4.2.

160-4.3.1.2 Mixing Depths: Meet required plan mixing-depths by measuring from the proposed Final Grade Line.

160-4.3.1.3 Modified Proctor Maximum Density Requirement: Collect enough material to split and create three separate samples.

285-8 Method of Measurement.

The quantity to be paid for will be the plan quantity area in square yards.

285-9 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section, including equipment, material required to achieve a subgrade LBR of 40, compaction, and testing.

Payment will be made under:

Item No. 160-1	8" Stabilized Subgrade - per Square Yard (SY)
Item No. 160-2	12" Stabilized Subgrade - per Square Yard (SY)

**SECTION 204
GRADED AGGREGATE BASE**

204-1 Description.

Construct a base course composed of graded aggregate.

204-2 Materials.

Use graded aggregate material, produced from Department approved sources, which yields a satisfactory mixture meeting all the requirements of these Specifications after it has been crushed and processed as a part of the mining operations.

The Contractor may furnish the material in two sizes of such gradation that, when combined in a central mix plant pugmill, the resultant mixture meets the required specifications.

Use graded aggregate base material of uniform quality throughout, substantially free from vegetable matter, shale, lumps and clay balls, and having a Limerock Bearing Ratio value of not less than 100. Use material retained on the No. 10 sieve composed of aggregate meeting the following requirements:

- Soundness Loss, Sodium, Sulfate: AASHTO T104 15%
- Percent Wear: AASHTO T96 (Grading A)
- Group 1 Aggregates 45%
- Group 2 Aggregates 65%
- Group 1: This group of aggregates is composed of limestone, marble, or dolomite.
- Group 2: This group of aggregates is composed of granite, gneiss, or quartzite.

Use graded aggregate base material meeting the following gradation:

<u>Sieve Size</u>	<u>Percent by Weight Passing</u>
2 inch	100
1 1/2 inch	95 to 100
3/4 inch	65 to 90
3/8 inch	45 to 75
No. 4	35 to 60
No. 10	25 to 45
No. 50	5 to 25
No. 200	0 to 10

For Group 1 aggregates, ensure that the fraction passing the No. 40 sieve has a Plasticity Index (AASHTO T90) of not more than 4.0 and a Liquid Limit (AASHTO T89) of not more than 25, and contains not more than 67% of the weight passing the No. 200 sieve.

For Group 2 aggregates, ensure that the material passing the No. 10 sieve has a sand equivalent (AASHTO T176) value of not less than 28.

The Contractor may use graded aggregate of either Group 1 or Group 2, but only use one group on any Contract. (Graded aggregate may be referred to hereinafter as “aggregate”.)

204-3 Equipment.

Provide equipment meeting the requirements of 200-3.

204-4 Transporting Aggregate.

Transport aggregate as specified in 200-4.

204-5 Spreading Aggregate.

Spread aggregate as specified in 200-5.

204-6 Compacting and Finishing Base.

204-6.1 General: Meet the requirements of 200-7.1 with density requirements of 204-6.3.

204-6.1.1 Single-Course Base: Construct as specified in 200-6.1.1.

204-6.1.2 Multiple-Course Base: Construct as specified in 200-6.1.2.

204-6.2 Moisture Content: Meet the requirements of 200-6.2.

204-6.3 Density Requirements: After attaining the proper moisture conditions, uniformly compact the material to a density of not less than 100% of the maximum density as determined by FM 1-T 180. Ensure that the minimum density that will be acceptable at any location outside the traveled roadway (such as intersections, crossovers, turnouts, etc.) is 98% of the maximum density.

204-6.4 Density Tests: Meet the requirements of 200-7.2.

204-6.5 Correction of Defects: Meet the requirements of 200-6.4.

204-6.6 Dust Abatement: Minimize the dispersion of dust from the base material during construction and maintenance operations by applying water or other dust control materials.

204-7 Testing Surface.

Test the surface in accordance with the requirements of 200-7.

204-8 Priming and Maintaining.

Meet the requirements of 200-8.

204-9 Thickness Requirements.

Meet the requirements of 285-6.

204-10 Calculations for Average Thickness of Base.

Calculations for determining the average thickness of base will be made in accordance with 285-7.

204-11 Method of Measurement.

204-11.1 General: The quantity to be paid for will be the area, in square yards, completed and accepted.

204-11.2 Authorized Normal Thickness Base: The surface area of authorized normal thickness base will be calculated as specified in 9-1.3, omitting any areas not allowed for payment under the provisions of 204-9 and omitting areas which are to be included for payment under 204-11.3. The area for payment, of authorized normal thickness base, will be the surface area determined as provided above, adjusted by adding or deducting, as appropriate, the area of base represented by the difference between the calculated average

thickness, determined as provided in 204-10, and the specified normal thickness, converted to equivalent square yards of normal thickness base.

204-11.3 Authorized Variable Thickness Base: As specified in 200-10.3.

204-12 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section, including dust abatement, correcting all defective surface and deficient thickness, removing cracks and checks and the additional aggregate required for such crack elimination.

Payment will be made under:

<i>Item No. 204-1</i>	<i>8" Graded Aggregate Base Course - per Square Yard. (SY)</i>
<i>Item No. 204-2</i>	<i>Graded Aggregate (Gravel) - per Square Yard. (SY)</i>

END OF ITEM 204

**SECTION 334
SUPERPAVE ASPHALT CONCRETE**

334-1 Description.

334-1.1 General: Construct a Superpave Asphalt Concrete pavement with the type of mixture specified in the Contract, or when offered as alternates, as selected. Superpave mixes are identified as Type SP-9.5, Type SP-12.5 or Type SP-19.0.

Meet the requirements of Section 320 for plant and equipment. Meet the general construction requirements of Section 330, except as modified herein, including the provision for Quality Control Plans and Quality Control Systems as specified in Section 105.

334-1.2 Traffic Levels: The requirements for Type SP Asphalt Concrete mixtures are based on the design traffic level of the project, expressed in 18,000 pound Equivalent Single Axle Loads (ESAL's). The five traffic levels are as shown in Table 334-1.

Table 334-1 Superpave Traffic Levels	
Traffic Level	Traffic Level (1x10 ⁶ ESAL's)
A	<0.3
B	0.3 to <3
C	3 to <10
>>> D	10 to <30
E	≥30

The traffic level for the project is a **TRAFFIC LEVEL D**. A Type SP mix one traffic level higher than the traffic level specified in the Contract may be substituted, at no cost to the Department (i.e. Traffic Level B may be substituted for Traffic Level A, etc.).

334-1.3 Gradation Classification: The Superpave mixes are classified as either coarse or fine, depending on the overall gradation of the mixture. Coarse and fine mixes are defined in 334-3.2.2.

The equivalent AASHTO nominal maximum aggregate size Superpave mixes are as follows:

Type SP 9.5.....	9.5 mm
Type SP-12.5.....	12.5 mm
Type SP 19.0.....	19.0 mm

334-1.4 Thickness: The total thickness of the Type SP asphalt layer(s) will be the plan thickness as shown in the Contract Documents. Before paving, propose a thickness for each individual layer meeting the requirements of this specification, which when combined with other layers (as applicable) will equal the plan thickness. For construction purposes, the plan thickness and individual layer thickness will be converted to spread rate based on the maximum specific gravity of the asphalt mix being used, as well as the minimum density level, as shown in the following equation:

$$\text{Spread rate (lbs/yd}^2\text{)} = t \times G_{\text{mm}} \times 43.3$$

Where: t = Thickness (in.) (Plan thickness or individual layer thickness)
 G_{mm} = Maximum specific gravity from the verified mix design

The weight of the mixture shall be determined as provided in 320-2.2. For target purposes only, spread rate calculations should be rounded to the nearest whole number.
Note: Plan quantities are based on a G_{mm} of 2.540, corresponding to a spread rate of 110 lbs/yd²-in. Pay quantities will be based on the actual maximum specific gravity of the mix being used.

334-1.4.1 Layer Thicknesses - Fine Mixes: The allowable layer thicknesses for fine Type SP Asphalt Concrete mixtures are as follows:

Type SP-9.5	1 - 1 1/2 inches
Type SP-12.5.....	1 1/2 - 2 1/2 inches
Type SP-19.0.....	2 - 3 inches

In addition to the minimum and maximum thickness requirements, the following restrictions are placed on fine mixes when used as a structural course:

- Type SP-9.5 - Limited to the top two structural layers, two layers maximum.
- Type SP-9.5 – May not be used on Traffic Level D and E applications.
- Type SP-19.0 - May not be used in the final (top) structural layer.

334-1.4.2 Layer Thicknesses - Coarse Mixes: The allowable layer thicknesses for coarse Type SP Asphalt Concrete mixtures are as follows:

Type SP-9.5	1 1/2 - 2 inches
Type SP-12.5.....	2 - 3 inches
Type SP-19.0.....	3 - 3 1/2 inches

In addition to the minimum and maximum thickness requirements, the following restrictions are placed on coarse mixes when used as a structural course:

- Type SP-19.0 - May not be used in the final (top) structural layer.

334-1.4.3 Additional Requirements: The following requirements also apply to coarse and fine Type SP Asphalt Concrete mixtures:

1. A minimum 1 1/2 inch initial lift is required over an Asphalt Rubber Membrane Interlayer (ARMI).
2. When construction includes the paving of adjacent shoulders (≤ 5 feet wide), the layer thickness for the upper pavement layer and shoulder must be the same and paved in a single pass, unless called for differently in the Contract Documents.
3. All overbuild layers must be fine Type SP Asphalt Concrete designed at the traffic level as stated in the Contract. Use the minimum and maximum layer thicknesses as specified above unless called for differently in the Contract Documents. On variable thickness overbuild layers, the minimum allowable thickness may be reduced by 1/2 inch, and the maximum allowable thickness

may be increased 1/2 inch, unless called for differently in the Contract Documents.

334-2 Materials.

334-2.1 General Requirements: Meet the material requirements specified in Division III. Specific references are as follows:

Superpave PG Asphalt Binder or	
Recycling Agent	916-1, 916-2
Coarse Aggregate.....	Section 901
Fine Aggregate.....	Section 902

334-2.2 Superpave Asphalt Binder: Unless specified otherwise in the Contract, use a PG 76-22 (Traffic Level D) asphalt binder. In addition, meet the requirements of 334-2.3.

334-2.3 Reclaimed Asphalt Pavement (RAP) Material:

334-2.3.1 General requirements: RAP may be used as a component of the asphalt mixture subject to the following requirements:

1. When using a PG 76-22 Asphalt Binder, limit the amount of RAP material used in the mix to a maximum of 20 percent by weight of total aggregate. As an exception, amounts greater than 20 percent RAP by weight of total aggregate can be used if no more than 20 percent by weight of the total asphalt binder comes from the RAP material.
2. Assume full responsibility for the design, production and construction of asphalt mixes which incorporate RAP as a component material.
3. Use RAP from an FDOT approved stockpile or RAP that has an FDOT furnished Pavement Composition Data Sheet.
4. Provide stockpiled RAP material that is reasonably consistent in characteristics and contains no aggregate particles which are soft or conglomerates of fines.
5. Provide RAP material having a minimum average asphalt binder content of 4.0 percent by weight of RAP. As an exception, when using fractionated RAP, the minimum average asphalt binder content for the coarse portion of the RAP shall be 2.5 percent by weight of the coarse portion of the RAP. The coarse portion of the RAP shall be the portion of the RAP retained on the No. 4 sieve. The Engineer may sample the stockpile(s) to verify that this requirement is met.

334-2.3.2 Material Characterization for Mix Design: Assume responsibility for establishing the asphalt binder content, gradation, viscosity and bulk specific gravity (G_{sb}) of the RAP material based on a representative sampling of the material by roadway cores or stockpile samples. For roadway core samples, assume responsibility for the degradation that will occur during the milling operation.

334-2.3.3 RAP Stockpile Approval: Prior to the incorporation of RAP into the asphalt mixture, stockpile the RAP material and obtain approval for the stockpile by one of the following methods:

1. Continuous stockpile: When RAP is obtained from one or multiple sources and is either processed, blended, or fractionated, and stockpiled in a continuous manner, assure an adequate number of test results are obtained for stockpile approval. Test the RAP material for gradation and asphalt content at a minimum frequency of 1 sample per 1000 tons with a minimum of six test results. Test the RAP material for G_{mm} (for G_{sb} determination) and for recovered viscosity at a minimum frequency of 1 sample per 5000 tons with a minimum of two test results. Based on visual inspection and a review of the test data, the Engineer will determine the suitability of the stockpiled material. In addition, address in the QC Plan the details and specifics of the processing, sampling, testing and actions to be taken.
2. Non-continuous single stockpile: When an individual stockpile is being constructed, obtain representative samples at random locations and test the RAP material for gradation and asphalt content at a minimum frequency of 1 sample per 1000 tons with a minimum of six test results. Test the RAP material for G_{mm} (for G_{sb} determination) and for recovered viscosity at a minimum frequency of 1 sample per 5000 tons with a minimum of two test results. Based on visual inspection and a review of the test data, the Engineer will determine the suitability of the stockpiled material. Once the RAP stockpile has been approved, do not add additional material without prior approval of the Engineer.

Determine the asphalt binder content and gradation of the RAP material in accordance with FM 5-563 and FM 1-T 030, respectively. Extract and recover the asphalt binder from the RAP in accordance with FM 5-524 and FM 3-D 5404, respectively. Determine the viscosity of the recovered asphalt binder in accordance with ASTM D 2171. Establish the G_{sb} of the RAP material by using one of the following methods:

- a. Calculate the G_{sb} value based upon the effective specific gravity (G_{se}) of the RAP material, determined on the basis of the asphalt binder content and maximum specific gravity (G_{mm}) of the RAP material. The Engineer will approve the estimated asphalt binder absorption value used in the calculation.
- b. Measure the G_{sb} of the RAP aggregate, in accordance with FM 1-T 084 and FM 1-T 085. Obtain the aggregate by using a solvent extraction method.

334-2.3.4 Pavement Composition: When the Contract includes milling of the existing asphalt pavement, the Pavement Composition Data Sheet may be available on the Department's website. The URL for obtaining this information, if available, is:
www.dot.state.fl.us/statematerialsoffice/laboratory/asphalt/centrallaboratory/compositions/index.shtm .

334-2.3.5 Asphalt Binder for Mixes with RAP: Select the appropriate asphalt binder grade based on Table 334-2. The Engineer reserves the right to change the asphalt binder type and grade at design based on the characteristics of the RAP asphalt binder, and reserves the right to make changes during production. Maintain the viscosity of the recycled mixture within the range of 5,000 to 15,000 poises. Obtain a sample of the mixture for the Engineer within the first 1,000 tons of production and at a continuing frequency of one sample per 4,000 tons of mix.

Table 334-2 Asphalt Binder Grade for Mixes Containing RAP	
Percent RAP	Asphalt Binder Grade
<20	PG 67-22
20 – 29	PG 64-22
≥ 30	Recycling Agent

334-2.4 Recycled Crushed Glass: Recycled crushed glass may be used as a component of the asphalt mixture subject to the following requirements:

1. Consider the recycled crushed glass a local material and meet all requirements specified in 902-6.
2. Limit the amount of recycled crushed glass to a maximum of 15 percent by weight of total aggregate.
3. Use an asphalt binder that contains a minimum of 0.5 percent anti-stripping agent by weight of binder. The antistripping additive shall be one of the products included on the Qualified Products List specified in 6-1 of the Specifications. The antistripping additive shall be introduced into the asphalt binder by the supplier during loading.
4. Do not use recycled crushed glass in friction course mixtures or in structural course mixtures which are to be used as the final wearing surface.

334-3 General Composition of Mixture.

334-3.1 General: Compose the asphalt mixture using a combination of aggregate (coarse, fine or mixtures thereof), mineral filler, if required, and asphalt binder material. Size, grade and combine the aggregate fractions to meet the grading and physical properties of the mix design. Aggregates from various sources may be combined.

334-3.2 Mix Design:

334-3.2.1 General: Design the asphalt mixture in accordance with AASHTO R35-04, except as noted herein. Prior to the production of any asphalt mixture, submit the proposed mix design with supporting test data indicating compliance with all mix design criteria to the Engineer. For Traffic Level B through E mix designs, include representative samples of all component materials, including asphalt binder. Allow the State Materials Engineer a maximum of four weeks to either conditionally verify or reject the mix as designed.

Do not use more than three mix designs per nominal maximum aggregate size per traffic level per binder grade per contract year. Exceeding this limitation will result in a maximum Composite Pay Factor of 1.00 as defined in 334-8.2 for all designs used beyond this limit.

Warm mix technologies (additives, foaming techniques, etc.) listed on the Department’s website may be used in the production of the mix. The URL for obtaining this information, if available, is:

<http://www.dot.state.fl.us/Specificationsoffice/implemented/URLinSpecs/files/WarmMixAsphalt.pdf> .

The Engineer will consider any marked variations from original test data for a mix design or any evidence of inadequate field performance of a mix design as sufficient evidence that the properties of the mix design have changed, and the Engineer will no longer allow the use of the mix design.

334-3.2.2 Mixture Gradation Requirements: Combine the coarse and fine aggregate in proportions that will produce an asphalt mixture meeting all of the requirements defined in this specification and conform to the gradation requirements at design as defined in AASHTO M323-07, Table 3. Aggregates from various sources may be combined.

334-3.2.2.1 Mixture Gradation Classification: Plot the combined mixture gradation on an FHWA 0.45 Power Gradation Chart. Include the Control Points from AASHTO M323-07, Table-3, as well as the Primary Control Sieve (PCS) Control Point from AASHTO M323-07, Table 4. Coarse mixes are defined as having a combined aggregate gradation that passes below the primary control sieve control point and below the maximum density line for all sieve sizes smaller than the primary control sieve. Fine mixes are defined as having a gradation that passes above the primary control sieve control point and above the maximum density line for all sieve sizes smaller than the primary control sieve and larger than the #100 sieve. Use a fine mix for Traffic Levels A through C; use either a coarse mix or fine mix for Traffic Levels D and E.

334-3.2.3 Aggregate Consensus Properties: For Traffic Level C through E mixtures, meet the following consensus properties at design for the aggregate blend.
Aggregate consensus properties do not apply to Traffic Level A and B mixtures.

334-3.2.3.1 Coarse Aggregate Angularity: When tested in accordance with ASTM D 5821, meet the percentage of fractured faces requirements specified in AASHTO M 323-07, Table 5.

334-3.2.3.2 Fine Aggregate Angularity: When tested in accordance with AASHTO T 304, Method A, meet the uncompacted void content of fine aggregate specified in AASHTO M 323-07, Table 5.

334-3.2.3.3 Flat and Elongated Particles: When tested in accordance with ASTM D 4791, (with the exception that the material passing the 3/8 inch sieve and retained on the No. 4 sieve shall be included), meet the requirements specified in AASHTO M 323-07, Table 5. Measure the aggregate using the ratio of 5:1, comparing the length (longest dimension) to the thickness (shortest dimension) of the aggregate particles.

334-3.2.3.4 Sand Equivalent: When tested in accordance with AASHTO T 176, meet the sand equivalent requirements specified in AASHTO M 323-07, Table 5.

334-3.2.4 Gyrotory Compaction: Compact the design mixture in accordance with AASHTO T 312-08, with the following exception: use the number of gyrations at N_{design} as defined in Table 334-3. Measure the inside diameter of gyrotory molds in accordance with FM 5-585.

Traffic Level	N _{design} Number of Gyration
A	50
B	65
C	75
D	100
E	100

334-3.2.5 Design Criteria: Meet the requirements for nominal maximum aggregate size as defined in AASHTO M323-07, as well as for relative density, VMA, VFA, and dust-to-binder ratio as specified in AASHTO M323-07, Table 6. Use a dust-to-binder ratio of 0.8 to 1.6 for coarse mixes. N_{maximum} requirements are not applicable for Traffic Level A and B mixtures.

334-3.2.6 Moisture Susceptibility:

1. For Traffic Level A and B mixtures, use a liquid anti-strip additive, which is on the Department's Qualified Products List, at a rate of 0.5% by weight of the asphalt binder. Other rates of anti-strip additive may be used upon approval of the Engineer,
2. For Traffic Level C through E mixtures, test 4 inch specimens in accordance with FM 1-T 283. Provide a mixture having a retained tensile strength ratio of at least 0.80 and a minimum tensile strength (unconditioned) of 100 psi. If necessary, add a liquid anti-stripping agent, which is on the Department's Qualified Products List and/or hydrated lime (meeting the requirements of Section 337) in order to meet these criteria.

334-3.2.7 Additional Information: In addition to the requirements listed above, provide the following information with each proposed mix design submitted for verification:

1. The design traffic level and the design number of gyrations (N_{design}).
2. The source and description of the materials to be used.
3. The DOT source number and the DOT product code of the aggregate components furnished from a DOT approved source.
4. The gradation and proportions of the raw materials as intended to be combined in the paving mixture. The gradation of the component materials shall be representative of the material at the time of use. Compensate for any change in aggregate gradation caused by handling and processing as necessary.
5. A single percentage of the combined mineral aggregate passing each specified sieve. Degradation of the aggregate due to processing (particularly material passing the No. 200 sieve) should be accounted for and identified.
6. The bulk specific gravity (G_{sb}) value for each individual aggregate and RAP component, as identified in the Department's aggregate control program.
7. A single percentage of asphalt binder by weight of total mix intended to be incorporated in the completed mixture, shown to the nearest 0.1 percent.
8. A target temperature for the mixture at the plant (mixing temperature) and a target temperature for the mixture at the roadway (compaction temperature) in accordance with 330-6.3. Do not exceed a target temperature of 330°F for PG 76-22 asphalt binders, 320°F for ARB-12 asphalt binders, and 315°F for ARB-5 and unmodified asphalt binders.

9. Provide the physical properties achieved at four different asphalt binder contents. One of which shall be at the optimum asphalt content, and must conform to all specified physical requirements.
10. The name of the CTQP Qualified Mix Designer.
11. The ignition oven calibration factor.
12. The warm mix technology, if used.

334-3.3 Mix Design Revisions: During production, the Contractor may request a target value revision to a mix design, subject to meeting the following requirements: (1) the target change falls within the limits defined in Table 334-4, (2) appropriate data exists demonstrating that the mix complies with production air voids specification criteria, and (3) the mixture gradation meets the basic gradation requirements defined in 334-3.2.2.

Table 334-4 Limits for Potential Adjustments to Mix Design Target Values	
Characteristic	Limit from Original Mix Design
No. 8 sieve and Coarser	± 5.0 percent
No. 16 sieve	± 4.0 percent
No. 30 sieve	± 4.0 percent
No. 50 sieve	± 3.0 percent
No. 100 sieve	± 3.0 percent
No. 200 sieve	± 1.0 percent
Asphalt Binder Content ⁽¹⁾	± 0.3 percent
Each Component of Aggregate Blend ⁽²⁾	± 5.0 percent

⁽¹⁾ Reductions to the asphalt binder content will not be permitted if the VMA during production is lower than 1.0 percent below the design criteria.

⁽²⁾ Revisions to FC-5 mixtures to be determined by the Engineer.

Submit all requests for revisions to mix designs, along with supporting documentation, to the Engineer. In order to expedite the revision process, the request for revision or discussions on the possibility of a revision may be made verbally, but must be followed up by a written request. The verified mix design will remain in effect until the Engineer authorizes a change. In no case will the effective date of the revision be established earlier than the date of the first communication between the Contractor and the Engineer regarding the revision.

A new design mix will be required if aggregate sources change, or for any substitution of an aggregate product with a different aggregate code, unless approved by the Engineer.

334-4 Contractor Process Control. Assume full responsibility for controlling all operations and processes such that the requirements of these Specifications are met at all times. Perform any tests necessary at the plant and roadway for process control purposes. Enter all Process Control test data into the Department’s Laboratory Information Management System (LIMS) database. The Engineer will not use these test results in the acceptance payment decision.

Address in the Quality Control Plan how Process Control failures will be handled. When a Process Control failure occurs, investigate, at a minimum, the production process, testing equipment and/or sampling methods to determine the cause of the failure, and make any necessary changes to assure compliance with these Specifications. Obtain a follow up sample immediately after corrective actions are taken to assess the adequacy of the corrections. In the event the follow-up Process Control sample also

fails to meet Specification requirements, cease production of the asphalt mixture until the problem is adequately resolved to the satisfaction of the Quality Control Manager.

334-5 Acceptance of the Mixture.

334-5.1 General: The mixture will be accepted at the plant with respect to gradation (P₈ and P₂₀₀), asphalt content (P_b), and volumetrics (volumetrics is defined as air voids at N_{design}). The mixture will be accepted on the roadway with respect to density of roadway cores. Acceptance will be on a LOT-by-LOT basis (for each mix design) based on tests of random samples obtained within each subplot taken at a frequency of one set of samples per subplot. A roadway LOT and a plant production LOT shall be the same. Acceptance of the mixture will be based on Contractor Quality Control test results that have been verified by the Department.

334-5.1.1 Sampling and Testing Requirements: Obtain the samples in accordance with FM 1-T 168. Obtain samples at the plant of a sufficient quantity to be split into three smaller samples; one for Quality Control, one for Verification and one for Resolution testing; each sample at approximately 35 pounds. The split samples for Verification testing and Resolution testing shall be reduced in size and stored in three boxes each. The approximate size of each box must be 12 inches x 8 inches x 4 inches. Provide, label and safely store sample boxes in a manner agreed upon by the Engineer for future testing.

The asphalt content of the mixture will be determined in accordance with FM 5-563. In the event the FM 5-563 ignition oven goes out of service during production, the Contractor may elect to use a replacement oven at another location for no more than 72 hours while the oven is being repaired. The gradation of the recovered aggregate will be determined in accordance with FM 1-T 030. Volumetric testing will be in accordance with AASHTO T 312-08 and FM 1-T 209. Measure the inside diameter of gyratory molds in accordance with FM 5-585. Prior to testing volumetric samples, condition the test-sized sample for one hour plus or minus five minutes at the target roadway compaction temperature in a covered, shallow, flat pan, such that the mixture temperature at the end of the one hour conditioning period is within plus or minus 20°F of the roadway compaction temperature. Test for roadway density in accordance with FM 1-T 166.

334-5.1.2 Acceptance Testing Exceptions: When the total combined quantity of hot mix asphalt for the project, as indicated in the plans for Type SP and Type FC mixtures only, is less than 2000 tons, the Engineer will accept the mix on the basis of visual inspection. The Engineer may require the Contractor to run process control tests for informational purposes, as defined in 334-4, or may run independent verification tests to determine the acceptability of the material.

Density testing for acceptance will not be performed on widening strips or shoulders with a width of 5 feet or less, open-graded friction courses, variable thickness overbuild courses, leveling courses, any asphalt layer placed on subgrade (regardless of type), miscellaneous asphalt pavement, bike/shared use paths, crossovers, or any course with a specified thickness less than 1 inch or a specified spread rate that converts to less than 1 inch as described in 334-1.4. Density testing for acceptance will not be performed on asphalt courses placed on bridge decks or approach slabs; compact these courses in static mode only per the requirements of 330-10.1.8. In addition, density testing for acceptance will not be performed on the following areas when they are less than 1,000 feet (continuous) in length: turning lanes, acceleration lanes, deceleration lanes, shoulders, parallel parking lanes or ramps.

Density testing for acceptance will not be performed in intersections. The limits of the intersection will be from stop bar to stop bar for both the mainline and side streets. A random core location that occurs within the intersection shall be moved forward or backward from the intersection at the direction of the Engineer.

Where density testing for acceptance is not required, compact these courses (with the exception of open-graded friction courses) in accordance with the rolling procedure (equipment and pattern) as approved by the Engineer or with Standard Rolling Procedure as specified in 330-10.1.2. In the event that the rolling procedure deviates from the procedure approved by the Engineer, or the Standard Rolling Procedure, placement of the mix shall be stopped.

The density pay factor (as defined in 334-8.2) for LOTs where there are areas not requiring density testing for acceptance will be prorated based on a pay factor of 1.00 for the quantity (tonnage) of material in areas not requiring density testing for acceptance and the actual pay factor for the tonnage of material in areas requiring density testing.

334-5.2 Full LOTs: Each LOT will be defined (as selected by the Contractor prior to the start of the LOT) as either (1) 2,000 tons, with each LOT subdivided into four equal sublots of 500 tons each, or (2) 4,000 tons, with each LOT subdivided into four equal sublots of 1,000 tons each. As an exception to this, the initial LOT of all new mix designs shall be defined as 2,000 tons, subdivided into four equal sublots of 500 tons each. Before the beginning of a LOT, the Engineer will develop a random sampling plan for each subplot and direct the Contractor on sample points, based on tonnage, for each subplot during construction.

334-5.3 Partial LOTs: A partial LOT is defined as a LOT size that is less than a full LOT. A partial LOT may occur due to the following:

1. The completion of a given mix type or mix design on a project.
2. Closure of the LOT due to time. LOTs will be closed 30 calendar days after the start of the LOT. Time periods other than 30 calendar days may be used if agreed to by both the Engineer and the Contractor.
3. A LOT is terminated per 334-5.4.4.

All partial LOTs will be evaluated based on the number of tests available, and will not be redefined.

334-5.4 Quality Control Sampling and Testing: Obtain all samples randomly as directed by the Engineer.

Should the Engineer determine that the Quality Control requirements are not being met or that unsatisfactory results are being obtained, or should any instances of falsification of test data occur, approval of the Contractor's Quality Control Plan will be suspended and production will be stopped.

334-5.4.1 Lost or Missing Verification/Resolution Samples: In the event that any of the Verification and/or Resolution samples that are in the custody of the Contractor are lost, damaged, destroyed, or are otherwise unavailable for testing, the minimum possible pay factor for each quality characteristic as described in 334-8.2 will be applied to the entire LOT in question, unless called for otherwise by the Engineer. Specifically, if the LOT in question has more than two sublots, the pay factor for each quality characteristic will be 0.55. If the LOT has two or less sublots, the pay factor for each quality characteristic will be 0.80. In either event, the material in question will also be evaluated in accordance with 334-5.9.5.

If any of the Verification and/or Resolution samples that are in the custody of the Department are lost, damaged, destroyed or are otherwise unavailable for testing, the corresponding Quality Control test result will be considered verified, and payment will be based upon the Contractor's data.

334-5.4.2 Plant Sampling and Testing Requirements: Obtain one random sample of mix per subplot in accordance with 334-5.1.1 as directed by the Engineer. Test the Quality Control split sample for gradation, asphalt binder content and volumetrics in accordance with 334-5.1.1. Complete all Quality Control testing within one working day from the time the samples were obtained.

334-5.4.3 Roadway Sampling and Testing Requirements: Obtain five 6 inch diameter roadway cores within 24 hours of placement at random locations as directed by the Engineer within each subplot. Test these Quality Control samples for density (G_{mb}) in accordance with 334-5.1.1. In situations where it is impractical to cut five cores per subplot, obtain a minimum of three cores per subplot at random locations as identified by the Engineer. Do not obtain cores any closer than 12 inches from an unsupported edge. Maintain traffic during the coring operation; core the roadway, patch the core holes (within three days of coring); and trim the cores to the proper thickness prior to density testing.

Density for the subplot shall be based on the average value for the cores cut from the subplot with the target density being the maximum specific gravity (G_{mm}) of the subplot. Once the average density of a subplot has been determined, do not retest the samples unless approved by the Engineer. Ensure proper handling and storage of all cores until the LOT in question has been accepted.

334-5.4.4 Individual Test Tolerances for Quality Control Testing: Terminate the LOT if any of the following Quality Control failures occur:

- 1) An individual test result of a subplot for air voids does not meet the requirements of Table 334-5,
- 2) The average subplot density for coarse mixes does not meet the requirements of Table 334-5,
- 3) Two consecutive test results for gradation (P_{-200}) do not meet the requirements of Table 334-5,
- 4) Two consecutive test results for asphalt binder content do not meet the requirements of Table 334-5,
- 5) The average subplot density for two consecutive sublots for fine mixes does not meet the requirements of Table 334-5,
- 6) Two core densities for coarse mixes within a subplot are less than 91.00% of G_{mm} .

When a LOT is terminated due to a QC failure, stop production of the mixture until the problem is resolved to the satisfaction of the Quality Control Manager(s) and/or Asphalt Plant Level II technician(s) responsible for the decision to resume production after a quality control failure, as identified in 105-8.6.4. In the event that it can be demonstrated that the problem can immediately be or already has been resolved, it will not be necessary to stop production. When a LOT is terminated, make all necessary changes to correct the problem. Do not resume production until appropriate corrections have been made. Inform the Engineer of the problem and corrections made to correct the problem. After resuming production, sample and test the material to verify that the changes have corrected the

problem. Summarize this information and provide it to the Engineer prior to the end of the work shift when production resumes.

In the event that a Quality Control failure is not addressed as defined above, the Engineer’s approval will be required prior to resuming production after any future Quality Control failures.

Address any material represented by a failing test result in accordance with 334-5.9.5. Any LOT terminated under this Subarticle will be limited to a maximum Pay Factor of 1.00 (as defined in 334-8.2) for each quality characteristic.

In the event that a G_{mm} test result differs by more than 0.040 from the mix design G_{mm} , investigate the cause(s) of the discrepancy and report the findings and proposed actions to the Engineer.

Characteristic	Tolerance ⁽¹⁾
Asphalt Binder Content (percent)	Target ± 0.55
Passing No. 200 Sieve (percent)	Target ± 1.50
Air Voids (percent) Coarse Graded	2.00 - 6.00
Air Voids (percent) Fine Graded	2.30 - 6.00
Density (percent G_{mm}) ⁽²⁾	
Coarse Graded (minimum)	93.00
Fine Graded (minimum)	90.00

⁽¹⁾ Tolerances for sample size of $n = 1$ from the verified mix design
⁽²⁾ Based on an average of 5 randomly located cores

334-5.5 Verification Testing: In order to determine the validity of the Contractor’s Quality Control test results prior to their use in the Acceptance decision, the Engineer will run verification tests.

334-5.5.1 Plant Testing: At the completion of each LOT, the Engineer will test a minimum of one Verification split sample randomly selected from the LOT. Results of the testing and analysis for the LOT will be made available to the Contractor within one working day from the time the LOT is completed. Verification samples shall be reheated at the target roadway compaction temperature for 1 1/2 hours plus or minus 5 minutes, reduced to the appropriate testing size, and conditioned and tested as described in 334-5.1.1.

The Verification test results will be compared with the Quality Control test results based on the between-laboratory precision values shown in Table 334-6.

Property	Maximum Difference
G_{mm}	0.016
G_{mb} (gyratory compacted samples)	0.022
G_{mb} (roadway cores – fine graded mixture)	0.015
G_{mb} (roadway cores – coarse graded mixture)	0.018
P_b	0.44 percent
P_{-200}	FM 1-T 030 (Figure 2)
P_{-8}	FM 1-T 030 (Figure 2)

If all of the specified mix characteristics compare favorably, then the LOT will be accepted, with payment based on the Contractor's Quality Control test data for the LOT.

If any of the results do not compare favorably, then the Resolution samples from the LOT will be sent to the Resolution laboratory for testing, as described in 334-5.6.

334-5.5.2 Roadway Testing: At the completion of each LOT, the Engineer will determine the density (G_{mb}) of each core (previously tested by Quality Control) as described in 334-5.1.1 from the same subplot as the Plant samples. For situations where roadway density is not required for the random subplot chosen, then another subplot shall be randomly chosen for roadway density cores only. Results of the testing and analysis for the LOT will be made available to the Contractor within one working day from the time the LOT is completed.

The individual Verification test results will be compared with individual Quality Control test results by the Engineer based on the between-laboratory precision values given in Table 334-6.

If each of the core test results compare favorably, then the LOT will be accepted with respect to density, with payment based on the Contractor's Quality Control test data for the LOT.

If any of the results do not compare favorably, then the core samples from the LOT will be sent to the Resolution laboratory for testing as specified in 334-5.6.

334-5.6 Resolution System:

334-5.6.1 Plant Samples: In the event of an unfavorable comparison between the Contractor's Quality Control test results and the Engineer's Verification test results on any of the properties identified in Table 334-6, the Resolution laboratory will test all of the split samples from the LOT for only the property (or properties) in question. Resolution samples shall be reheated at the target roadway compaction temperature for 1-1/2 hours plus or minus 5 minutes, reduced to the appropriate testing size, and conditioned and tested as described in 334-5.1.1.

334-5.6.2 Roadway Samples: In the event of an unfavorable comparison between the Contractor's Quality Control test data and the Engineer's Verification test data on the density results, the Resolution laboratory will test all of the cores from the LOT. Testing will be as described in 334-5.1.1. Any damaged roadway cores will not be included in the evaluation; replace damaged cores with additional cores at the direction of the Engineer.

334-5.6.3 Resolution Determination: The Resolution test results (for the property or properties in question) will be compared with the Quality Control test results based on the between-laboratory precision values shown in Table 334-6.

If the Resolution laboratory results compare favorably with all of the Quality Control results, then acceptance and payment for the LOT will be based on the Quality Control results, and the Department will bear the costs associated with Resolution testing. No additional compensation, either monetary or time, will be made for the impacts of any such testing.

If the Resolution laboratory results do not compare favorably with all of the Quality Control results, then acceptance and payment for the LOT will be based on the Resolution test data for the LOT, and the costs of the Resolution testing will be deducted from monthly estimates. No additional time will be granted for the impacts of any such testing. In addition, in the event that

the application of the Resolution test data results in a failure to meet the requirements of Table 334-5, address any material represented by the failing test result in accordance with 334-5.9.5.

In the event of an unfavorable comparison between the Resolution test results and Quality Control test results, make the necessary adjustments to assure that future comparisons are favorable.

334-5.7 Independent Verification Testing:

334-5.7.1 Plant: The Contractor shall provide sample boxes and take samples as directed by the Engineer for Independent Verification testing. Obtain enough material for three complete sets of tests (two samples for Independent Verification testing by the Engineer and one sample for testing by the Contractor). If agreed upon by both the Engineer and the Contractor, only one sample for Independent Verification testing by the Engineer may be obtained. Independent Verification samples will be reheated at the target roadway compaction temperature for 1-1/2 hours plus or minus 5 minutes, reduced to the appropriate testing size, and conditioned and tested as described in 334-5.1.1. The Contractor's split sample, if tested immediately after sampling, shall be reduced to the appropriate testing size, and conditioned and tested as described in 334-5.1.1. If the Contractor's sample is not tested immediately after sampling, then the sample shall be reheated at the target roadway compaction temperature for 1-1/2 hours plus or minus 5 minutes, reduced to the appropriate testing size, and conditioned and tested as described in 334-5.1.1. The Contractor's test results shall be provided to the Engineer within one working day from the time the sample was obtained.

If any of the Independent Verification test results do not meet the requirements of Table 334-5, then a comparison of the Independent Verification test results and the Contractor's test results, if available, will be made. If a comparison of the Independent Verification test results and the Contractor's test results meets the precision values of Table 334-6 for the material properties in question, or if the Contractor's test results are not available, then the Independent Verification test results are considered verified and the Contractor shall cease production of the asphalt mixture until the problem is adequately resolved (to the satisfaction of the Engineer), unless it can be demonstrated to the satisfaction of the Engineer that the problem can immediately be (or already has been) resolved. Address any material represented by the failing test results in accordance with 334-5.9.5.

If a comparison of the Independent Verification test results and the Contractor's test results does not meet the precision values of Table 334-6 for the material properties in question, then the second Independent Verification sample shall be tested by the Engineer for the material properties in question. If a comparison between the first and second Independent Verification test results does not meet the precision values of Table 334-6 for the material properties in question, then the first Independent Verification test results are considered unverified for the material properties in question and no action shall be taken.

If a comparison between the first and second Independent Verification test results meets the precision values of Table 334-6 for the material properties in question, then the first Independent Verification sample is considered verified and the Contractor shall cease production of the asphalt mixture until the problem is adequately resolved (to the satisfaction of the Engineer), unless it can be demonstrated to the satisfaction of the Engineer that the problem can immediately be (or already has been) resolved. Address any material represented by the failing test results in accordance with 334-5.9.5.

The Engineer has the option to use the Independent Verification sample for comparison testing as specified in 334-6.

334-5.7.2 Roadway: Obtain five 6 inch diameter roadway cores within 24 hours of placement, as directed by the Engineer, for Independent Verification testing. In situations where it is impractical to cut five cores per subplot, obtain a minimum of three cores per subplot at random locations, as identified by the Engineer. These independent cores will be obtained from the same LOTs and sublots as the Independent Verification Plant samples, or as directed by the Engineer. The density of these cores will be obtained as described in 334-5.1.1. If the average of the results for the subplot does not meet the requirements of Table 334-5 for density, cease production of the asphalt mixture until the problem is adequately resolved (to the satisfaction of the Engineer), unless it can be demonstrated to the satisfaction of the Engineer that the problem can immediately be (or already has been) resolved. Address any material represented by the failing test results in accordance with 334-5.9.5.

334-5.8 Surface Tolerance: The asphalt mixture will be accepted on the roadway with respect to surface tolerance in accordance with the applicable requirements of 330-12.

334-5.9 Minimum Acceptable Quality Levels:

334-5.9.1 Pay Factors Below 0.90: In the event that an individual pay factor for any quality characteristic of a LOT falls below 0.90, take steps to correct the situation and report the actions to the Engineer. In the event that the pay factor for the same quality characteristic for two consecutive LOTs is below 0.90, cease production of the asphalt mixture until the problem is adequately resolved (to the satisfaction of the Engineer), unless it can be demonstrated to the satisfaction of the Engineer that the problem can immediately be (or already has been) resolved. Actions taken must be approved by the Engineer before production resumes.

334-5.9.2 Composite Pay Factors Less Than 0.90 and Greater Than or Equal to 0.80: If the composite pay factor for the LOT is less than 0.90 and greater than or equal to 0.80, cease production of the asphalt mixture until the problem is adequately resolved (to the satisfaction of the Engineer), unless it can be demonstrated to the satisfaction of the Engineer that the problem can immediately be (or already has been) resolved. Actions taken must be approved by the Engineer before production resumes.

334-5.9.3 Composite Pay Factors Less Than 0.80 and Greater Than or Equal to 0.75: If the composite pay factor for the LOT is less than 0.80 and greater than or equal to 0.75, address the defective material in accordance with 334-5.9.5.

334-5.9.4 Composite Pay Factors Less Than 0.75: If the composite pay factor for the LOT is less than 0.75, remove and replace the defective LOT at no cost to the Department, or as approved by the Engineer.

334-5.9.5 Defective Material: Assume responsibility for removing and replacing all defective material placed on the project, at no cost to the Department.

As an exception to the above and upon approval of the Engineer, obtain an engineering analysis by an independent laboratory (as approved by the Engineer) to determine the disposition of the material. The engineering analysis must be signed and sealed by a Professional Engineer licensed in the State of Florida.

The Engineer may determine that an engineering analysis is not necessary or may perform an engineering analysis to determine the disposition of the material.

Any material that remains in place will be accepted with a composite pay factor as determined by 334-8, or as determined by the Engineer.

If the defective material is due to a gradation, asphalt binder content or density failure, upon approval of the Engineer the Contractor may perform delineation tests on roadway cores in lieu of an engineering analysis to determine the limits of the defective material that requires removal and replacement. Prior to any delineation testing, all sampling locations shall be approved by the Engineer. All delineation sampling and testing shall be monitored and verified by the Engineer. The minimum limit of removal of defective material is fifty-feet either side of the failed sample. For materials that are defective due to air voids, an engineering analysis is required.

When evaluating defective material by engineering analysis or delineation testing, at a minimum, evaluate all material located between passing Quality Control, Process Control or Independent Verification test results. Exceptions to this requirement shall be approved by the Engineer.

334-6 Comparison Testing.

At the start of the project (unless waived by the Engineer) and at other times as determined necessary by the Engineer, provide split samples for comparison testing with the Engineer. The purpose of these tests is to verify that the testing equipment is functioning properly and that the testing procedures are being performed correctly. In the event that the Engineer determines that there is a problem with the Contractor's testing equipment and/or testing procedures, immediately correct the problem to the Engineer's satisfaction. In the event that the problem is not immediately corrected, cease production of the asphalt mixture until the problem is adequately resolved to the satisfaction of the Engineer.

If so agreed to by both the Contractor and the Engineer, the split sample used for comparison testing may also be used for the Quality Control sample. The split sample used for comparison testing will also meet the requirements for Independent Verification Testing described in 334-5.7.

334-7 Method of Measurement.

For the work specified under this Section (including the pertinent provisions of Sections 320 and 330), the quantity to be paid for will be the weight of the mixture, in tons. The pay quantity will be based on the project average spread rate, excluding overbuild, limited to a maximum of 105% of the spread rate determined in accordance with 334-1.4 or as set by the Engineer. The project average spread rate is calculated by totaling the arithmetic mean of the average daily spread rate values for each layer.

The bid price for the asphalt mix will include the cost of the liquid asphalt or the asphalt recycling agent and the tack coat application as directed in 300-8. There will be no separate payment or unit price adjustment for the asphalt binder material in the asphalt mix. For the calculation of unit price adjustments of bituminous material, the average asphalt content will be based on the percentage specified in 9-2.1.2. The weight will be determined as provided in 320-2 (including the provisions for the automatic recordation system).

Prepare a Certification of Quantities, using the Department's current approved form, for the certified Superpave asphalt concrete pay item. Submit this certification to the Engineer no later than Twelve O'clock noon Monday after the estimate cut-off or as directed by the Engineer, based on the quantity of asphalt produced and accepted on the roadway per Contract. The certification must include the Contract

Number, FPID Number, Certification Number, Certification Date, period represented by Certification and the tons produced for each asphalt pay item.

334-8 Basis of Payment.

334-8.1 General: Price and payment will be full compensation for all the work specified under this Section (including the applicable requirements of Sections 320 and 330).

For materials accepted in accordance with 334-5, based upon the quality of the material, a pay adjustment will be applied to the bid price of the material as determined on a LOT by LOT basis. The pay adjustment will be assessed by calculating a Pay Factor for the following individual quality characteristics: pavement density, air voids, asphalt binder content, and the percentage passing the No. 200 and No. 8 sieves. The pay adjustment will be computed by multiplying a Composite Pay Factor for the LOT by the bid price per ton. Perform all calculations with the Department’s Asphalt Plant - Pay Factor Worksheets.

334-8.2 Pay Factors:

334-8.2.1 Partial LOTs: For Partial LOTs where no random sample is obtained due to insufficient tonnage, a Composite Pay Factor of 1.00 shall be applied.

334-8.2.2 Two or Less Sublot Test Results: In the event that two or less sublot test results are available for a LOT, Pay Factors will be determined based on the Small Quantity Pay Table. The Small Quantity Pay Table and Pay Factor calculations are determined in accordance with the instructions contained within the Department’s Asphalt Plant – Pay Factor Worksheets.

334-8.2.3 Three or More Sublot Test Results: When three or more sublot test results are available for a LOT, the variability-unknown, standard deviation method will be used to determine the estimated percentage of the LOT that is within the specification limits shown in (Table 334-7). The Percent Within Limits (PWL) is determined in accordance with the instructions contained within the Department’s Asphalt Plant – Pay Factor Worksheets.

Table 334-7 Specification Limits	
Quality Characteristic	Specification Limits
Passing No. 8 sieve (percent)	Target ± 3.1
Passing No. 200 sieve (percent)	Target ± 1.0
Asphalt Content (percent)	Target ± 0.40
Air Voids - Coarse Mixes (percent)	4.00 ± 1.40
Air Voids - Fine Mixes (percent)	4.00 ± 1.20
Density - Coarse Mixes (percent of G _{mm}):	94.50 ± 1.30
Density - Fine Mixes (percent of G _{mm}):	93.00 + 2.00, - 1.20 ⁽¹⁾

Note (1): If the Engineer (or Contract Documents) limits compaction to the static mode only, or for all one-inch thick lifts, compaction shall be in the static mode. No vibratory mode in the vertical direction will be allowed. Other vibratory modes will be allowed, if approved by the Engineer. In either case, the specification limits will be as follows: 92.00 + 3.00, -1.20 percent of G_{mm}. No additional compensation, cost or time, shall be made.

334-8.2.3.1 Pay Factors (PF): Pay Factors will be calculated by using the following equation:

$$\text{Pay Factor} = (55 + 0.5 \times \text{PWL}) / 100$$

The PWL is determined in accordance with the instructions contained within the Department's Asphalt Plant – Pay Factor Worksheets.

334-8.3 Composite Pay Factor (CPF): A Composite Pay Factor for the LOT will be calculated based on the individual Pay Factors (PF) with the following weighting applied: 35% Density (D), 25% Air Voids (V_a), 25% asphalt binder content (P_b), 10% Passing No. 200 (P_{-200}) and 5% Passing No. 8 (P_{-8}). Calculate the CPF by using the following formula:

$$\text{CPF} = [(0.350 \times \text{PF } D) + (0.250 \times \text{PF } V_a) + (0.250 \times \text{PF } P_b) + (0.100 \times \text{PF } P_{-200}) + (0.050 \times \text{PF } P_{-8})]$$

Where the Pay Factor (PF) for each quality characteristic is determined in either 334-8.2.2 or 334-8.2.3, depending on the number of subplot tests. Note that the number after each multiplication will be rounded to the nearest 0.01.

The pay adjustment shall be computed by multiplying the Composite Pay Factor for the LOT by the bid price per ton.

334-8.4 Payment: Payment will be made under:

Item No. 334-1 2" Bituminous Surface Course - per Ton (TN).

SECTION 346
PORTLAND CEMENT CONCRETE

346-1 Description.

Use concrete composed of a mixture of portland cement, aggregate, water, and, where specified, admixtures, pozzolan and ground granulated blast furnace slag. Deliver the portland cement concrete to the site of placement in a freshly mixed, unhardened state.

Obtain concrete from a plant that is currently on the list of Producers with Accepted Quality Control Programs. Producers seeking inclusion on the list shall meet the requirements of 105-3. If the concrete production facility's Quality Control Plan is suspended, the Contractor is solely responsible to obtain the services of another concrete production facility with an accepted Quality Control Plan or await the re-acceptance of the affected concrete production facility's Quality Control Plan prior to the placement of any further concrete on the project. There will be no changes in the contract time or completion dates. Bear all delay costs and other costs associated with the concrete production facility's Quality Control Plan acceptance or re- acceptance.

346-2 Materials.

346-2.1 General: Meet the following requirements:

Coarse Aggregate.....	Section 901
Fine Aggregate*.....	Section 902
Portland Cement.....	Section 921
Water.....	Section 923
Admixtures**.....	Section 924
Pozzolans and Slag	Section 929

*Use only silica sand except as provided in 902-5.2.3.

**Use products listed on the Department's Qualified Products List (QPL).

Do not use materials containing hard lumps, crusts or frozen matter, or that is contaminated with dissimilar material in excess of that specified in the above listed Sections.

346-2.2 Types of Cement: Unless a specific type of cement is designated elsewhere, use Type I, Type IP, Type IS, Type II, Type II (MH) or Type III cement in all classes of concrete. Use Type II (MH) for all mass concrete elements.

Use only the types of cements designated for each environmental condition in structural concrete. A mix design for a more aggressive environment may be substituted for a lower aggressive environmental condition.

TABLE 1			
BRIDGE SUPERSTRUCTURES			
Component	Slightly Aggressive Environment	Moderately Aggressive Environment	Extremely Aggressive Environment
Precast Superstructure and Prestressed Elements	Type I or Type III	Type I, Type II, Type III, Type IP, or Type IS	Type II (MH)
Cast In Place	Type I	Type I, Type II, Type IP, or Type IS	Type II (MH)
BRIDGE SUBSTRUCTURE, DRAINAGE STRUCTURES AND OTHER STRUCTURES			
All Elements	Type I or Type III	Type I, Type II, Type IP, or Type IS	Type II (MH)

346-2.3 Pozzolans and Slag: Fly ash or slag materials are required in all classes of concrete. Use fly ash or slag materials as a cement replacement, on an equal weight replacement basis with the following limitations:

- (1) Mass Concrete:
 - a. Fly Ash - Ensure that the quantity of cement replaced with fly ash is 18% to 50% by weight, except where the core temperature is expected to rise above 165°F. In that case, ensure that the percentage of fly ash is 35% to 50% by weight.
 - b. Slag - Ensure that the quantity of cement replaced with slag is 50% to 70% by weight. Ensure that slag is 50% to 55% of total cementitious content by weight when used in combination with silica fume, ultrafine fly ash and/or metakaolin.
 - c. Fly Ash and Slag - Ensure that there is at least 20% fly ash by weight and 40% portland cement by weight for mixes containing portland cement, fly ash and slag.
- (2) Drilled Shaft:
 - a. Fly Ash - Ensure that the quantity of cement replaced with fly ash is 33% to 37% by weight.
 - b. Slag - Ensure that the quantity of cement replaced with slag is 58% to 62% by weight.
- (3) Precast Concrete – Ensure that the precast concrete has a maximum of 25% fly ash or a maximum of 70% slag. In extremely aggressive environments, ensure that the precast concrete has a minimum of 18% fly ash or a minimum of 50% slag.
- (4) For all other concrete uses not covered in (1), (2) and (3) above,
 - a. Fly Ash - Ensure that the quantity of cement replaced with fly ash is 18% to 30% by weight.
 - b. Slag - Ensure that the quantity of cement replaced with slag is 25% to 70% for slightly and moderately aggressive environments and 50% to 70% by weight when used in extremely aggressive environments. Ensure that slag is 50% to 55% of total cementitious content by weight when used in combination with silica fume, ultra fine fly ash and/or metakaolin.
 - c. Fly Ash and Slag (Ternary Blend) - Ensure that there is at least 20% fly ash by weight and 40% portland cement by weight for mixes containing portland cement, fly ash and slag.
- (5) Blended Cements:
 - a. Type IS - Ensure that the quantity of slag in Type IS is less than or equal to 70% by weight.
 - b. Type IP - Ensure that the quantity of the pozzolan in Type IP is less than or equal to 40% by weight.
- (6) Silica Fume, Metakaolin and Ultrafine Fly Ash - When silica fume, metakaolin or ultrafine fly ash is used, it must be used in combination with fly ash or slag.

- a. Silica Fume - Ensure that the quantity of cementitious material replaced with silica fume is 3% to 9% by weight.
- b. Metakaolin - Ensure that the quantity of cementitious material replaced with metakaolin is 8% to 12% by weight.
- c. Ultrafine Fly Ash - Ensure that the quantity of cementitious material replaced with ultrafine fly ash is 8% to 12% by weight.
- d. Cure in accordance with the manufacturer's recommendation and as approved by the Engineer.

346-2.4 Coarse Aggregate Gradation: Produce all concrete using Size No. 57, 67 or 78 coarse aggregate. With the Engineer's approval, Size No. 8 or Size No. 89 may be used either alone or blended with Size No. 57, 67 or 78 coarse aggregate. The Engineer will consider requests for approval of other gradations individually. Submit sufficient statistical data to establish production quality and uniformity of the subject aggregates, and establish the quality and uniformity of the resultant concrete. Furnish aggregate gradations sized larger than nominal maximum size of 1.5 inch as two components.

For Class I and Class II, excluding Class II (Bridge Deck), the coarse and fine aggregate gradation requirements set forth in Sections 901 and 902 are not applicable and the aggregates may be blended; however, the aggregate sources must be approved by the Department. Do not blend the aggregate if the size is smaller than Size No. 78.

346-2.5 Admixtures: Use admixtures in accordance with the requirements of this subarticle. Chemical admixtures not covered in this subarticle may be approved by the Department. Submit statistical evidence supporting successful laboratory and field trial mixes which demonstrate improved concrete quality or handling characteristics.

Use admixtures in accordance with the manufacturer's recommended dosage rate. Dosage rates outside of this range may be used with written recommendation from the admixture producer's technical representative. Do not use admixtures or additives containing calcium chloride (either in the raw materials or introduced during the manufacturing process) in reinforced concrete.

346-2.5.1 Water-Reducer/Water-Reducer Retardant Admixtures: When a water-reducing admixture is used, meet the requirements of a Type A. When a water-reducing and retarding admixture is used, meet the requirements of a Type D.

346-2.5.2 Air Entrainment Admixtures: Use an air entraining admixture in all concrete mixes except counterweight concrete. For precast concrete products, the use of air entraining admixture is optional for Class I and Class II concrete.

346-2.5.3 High Range Water-Reducing Admixtures:

346-2.5.3.1 General: When a high range water-reducing admixture is used, meet the requirements of a Type F or Type I. When a high range water-reducing and retarding admixture is used, meet the requirements of a Type G or Type II. Do not use Type I, II, F or G admixtures in drilled shaft concrete. When silica fume or metakaolin is incorporated into a concrete mix design, use a high range water-reducing admixture Type I, II, F or G.

346-2.5.3.2 Flowing Concrete Admixtures for Precast/Prestressed Concrete: Use a Type I, II, F or G admixture for producing flowing concrete. If Type F or G admixture is used, verify the distribution of aggregates in accordance with ASTM C 1610 except allow for minimal vibration for consolidating the concrete. The maximum allowable difference between the static segregation is less than or equal to 15

percent. Add the flowing concrete admixtures at the concrete production facility.

346-2.5.4 Corrosion Inhibitor Admixture: Use only with concrete containing Type II cement, or Type II (MH) cement, and a water-reducing retardant admixture, Type D, or High Range Water-Reducer retarder admixture, Type G, to normalize the setting time of concrete. Ensure that all admixtures are compatible with the corrosion inhibitor admixture.

346-2.5.5 Accelerating Admixture for Precast Concrete: The use of non- chloride admixtures Type C or Type E is allowed in the manufacturing of precast concrete products that are used in slightly aggressive environments.

346-3 Classification, Strength, Slump and Air Content.

346-3.1 General: The separate classifications of concrete covered by this Section are designated as Class I, Class II, Class III, Class IV, Class V and Class VI. Strength and slump are specified in Table 2. The air content range for all classes of concrete is 1.0 to 6.0%, except for Class IV (Drilled Shaft) which is 0.0 to 6.0%.

Substitution of a higher class concrete in lieu of a lower class concrete may be allowed when the substituted concrete mixes are included as part of the Contractor’s Quality Control Plan, or for precast concrete, the Precast Concrete Producer’s Quality Control Plan. The substituted higher class concrete must meet or exceed the requirements of the lower class concrete and both classes must contain the same types of mix ingredients. When the compressive strength acceptance data is less than the minimum compressive strength of the higher design mix, notify the Engineer. Acceptance is based on the requirements in Table 2 for the lower class concrete.

TABLE 2		
Class of Concrete	Specified Minimum Strength (28-day) (psi)	Target Slump Value (inches) (c)
STRUCTURAL CONCRETE		
I (a)	3,000	3 (b)
I (Pavement)	3,000	2
II (a)	3,400	3 (b)
II (Bridge Deck)	4,500	3 (b)
III (e)	5,000	3 (b)
III (Seal)	3,000	8
IV	5,500	3 (b) (d)
IV (Drilled Shaft)	4,000	8.5
V (Special)	6,000	3 (b) (d)
V	6,500	3 (b) (d)
VI	8,500	3 (b) (d)

- (a) For precast three-sided culverts, box culverts, endwalls, inlets, manholes and junction boxes, the target slump value and air content will not apply. The maximum allowable slump is 6 inches, except as noted in (b). The Contractor is permitted to use concrete meeting the requirements of

ASTM C 478 4,000 psi in lieu of Class I or Class II concrete for precast endwalls, inlets, manholes and junction boxes.

- (b) The Engineer may allow a higher target slump when a Type F, G, I or II admixture is used, except when flowing concrete is used. The maximum target slump shall be 7 inches.
- (c) For a reduction in the target slump for slip-form operations, submit a revision to the mix design to the Engineer.
- (d) When the use of silica fume, ultrafine fly ash, or metakaolin is required as a pozzolan in Class IV, Class V, Class V (Special) or Class VI concrete, ensure that the concrete exceeds a resistivity of 29 KOhm-cm at 28 days, when tested in accordance with FM 5-578. Submit three 4 x 8 inch cylindrical test specimens to the Engineer for resistivity testing before mix design approval. Take the resistivity test specimens from the concrete of the laboratory trial batch or from the field trial batch of at least 3 cubic yards. Verify the mix proportioning of the design mix and take representative samples of trial batch concrete for the required plastic and hardened property tests. Cure the field trial batch specimens similar to the standard laboratory curing methods. Submit the resistivity test specimens at least 7 calendar days prior to the scheduled 28 day test. The average resistivity of the three cylinders, eight readings per cylinder, is an indicator of the permeability of the concrete mix.
- (e) When precast three-sided culverts, box culverts, endwalls, inlets, manholes or junction boxes require a Class III concrete, the minimum cementitious materials is 470 pounds per cubic yard. Do not apply the air content range and the maximum target slump shall be 6 inches, except as allowed in (b).

346-3.2 Drilled Shaft Concrete: Notify the Engineer at least 48 hours before placing drilled shaft concrete. Obtain slump loss tests results demonstrating that the drilled shaft concrete maintains a slump of at least 5 inches throughout the concrete elapsed time before drilled shaft concrete operations begin, using personnel meeting the requirements of Section 105. The concrete elapsed time is defined in Section 455. Obtain the Engineer's approval for use of slump loss test results including elapsed time before concrete placement begins.

Test each load of concrete for slump to ensure the slump is within the limits of 346-6.4.

If the elapsed time during placement exceeds the slump loss test data, cast cylinders to verify the strength. Provide an engineering analysis performed by a Professional Engineer, registered in the State of Florida, knowledgeable in the area of foundations, to determine if the shaft is structurally sound and there are no voids in the drilled shaft concrete. At the direction of the Engineer, excavate the drilled shaft for inspection. Obtain approval from the Engineer before placing any additional shafts.

346-3.3 Mass Concrete: When mass concrete is designated in the Contract Documents, provide an analysis of the anticipated thermal developments in the mass concrete elements for all expected project temperature ranges using the selected mix design, casting procedures, and materials.

Use a Specialty Engineer competent in the design and temperature control of concrete in mass elements. The Specialty Engineer shall follow the procedure outlined in Section 207 of the ACI Manual of Concrete Practice to formulate, implement, administer and monitor a temperature control plan, making adjustments as necessary to ensure compliance with the Contract Documents. The Specialty Engineer shall select the concrete design mix proportions that will generate the lowest maximum temperatures possible to ensure that a 35°F differential temperature between the concrete core and the exterior surface is not exceeded. The mass concrete maximum allowable temperature is 180°F. If either the differential temperature or the maximum allowable temperature is exceeded, the Specialty Engineer shall be available for immediate consultation.

Describe the measures and procedures intended for use to maintain a temperature differential of 35°F or less between the interior core center and exterior surface(s) of the designated mass concrete elements during curing. Submit both the mass concrete mix design and the proposed mass concrete plan to monitor and control the temperature differential to the Engineer for acceptance. Provide temperature monitoring devices to record temperature development between the interior core center and exterior surface(s) of the elements in accordance with the accepted mass concrete plan.

The Specialty Engineer, or a person designated by the Specialty Engineer, must personally inspect and approve the installation of monitoring devices and verify that the process for recording temperature readings is effective for the first placement of each size and type mass component. Submit to the Engineer for approval the qualification of all technicians employed to inspect or monitor mass concrete placements. Designate an employee(s) approved by the Specialty Engineer, as qualified to inspect monitoring device installation, to record temperature readings, to be in contact at all times with the Specialty Engineer if adjustments must be made as a result of the temperature differential or the maximum allowable temperature being exceeded, and to immediately implement adjustments to temperature control measures as directed by the Specialty Engineer. Read the monitoring devices and record the readings at intervals no greater than 6 hours. The readings will begin when the mass concrete placement is complete and continue until the maximum temperature differential and the temperature is reached and a decreasing temperature differential is confirmed as defined in the temperature control plan. Do not remove the temperature control mechanisms until the core temperature is within 50°F of the ambient temperature. Furnish a copy of all temperature readings to the Engineer. Provide determined temperature differentials, the summary sheet from the data logger, which includes the maximum temperature, the maximum temperature differential and a final report within three calendar days of completion of monitoring of each element.

Request approval of reduced monitoring of same least dimensioned mass concrete elements containing the same mix design, concrete placement temperatures (within plus 3°F), and insulation thermal resistance value. The Specialty Engineer may monitor and record the temperature for the first element only. Each subsequent element must be started within one hour of the first placement and be completed within one hour of the completion of the first element. Each mass concrete element must be instrumented with monitoring devices in case of failure in meeting the one hour time limit.

Changes or adjustments made to the monitored element must be made to all elements. Failure to follow this will require an Engineering Analysis Report (EAR) for the elements not monitored even if the element that was monitored had a temperature differential well below the maximum allowed. The reduced monitoring option will not be allowed by the Engineer if the Contractor fails to comply with these requirements.

If the 35°F differential or the 180°F maximum allowable temperature has been exceeded, take immediate action as directed by the Specialty Engineer to retard further growth of the temperature differential. Describe methods of preventing thermal shock in the temperature control plan. Use a Specialty Engineer to revise the previously accepted plan to ensure compliance on future placements. Do not place any mass concrete until the Engineer has accepted the mass concrete plan(s). When mass concrete temperature differentials or maximum allowable temperature has been exceeded, provide all analyses and test results deemed necessary by the Engineer for determining the structural integrity and durability of the mass concrete element, to the satisfaction of the Engineer. The Department will make no compensation, either monetary or time, for the analyses or tests or any impacts upon the project.

346-3.4 Flowing Concrete for Precast/Prestressed Concrete: Produce flowing concrete mix with target slump of 9 inches.

Subsequent to the laboratory trial batch, perform a field demonstration of the proposed mix design by production and placement of at least three batches, 3 cubic yard minimum size each, of concrete containing flowing concrete HRWR admixture. Take representative samples from each batch and perform slump, air content, density (unit weight), and temperature tests on these samples. Cast specimens from each sample for compressive strength tests. Record the ambient air temperature during the test. Ensure that the concrete properties are within the required specification limits. The plants that are producing concrete with batch sizes of less than 3 cubic yards are required to produce and place at least a total amount of 9 cubic yards and perform the aforementioned tests on at least three randomly selected batches.

Determine the workability of the demonstration concrete batches by performing the slump tests on the samples taken at 15 minute intervals from each batch. Continue sampling and testing until the slump measures 6 inches or less. From the plot of slump versus time, determine the time for each batch when the slump is at 7.5 inches. The shortest time period determined from three consecutive batches, at 7.5 inches slump, is considered the cutoff time of the proposed concrete mix. For production concrete, ensure that the time between the batching and depositing of each load of concrete is less than the cutoff time of the mix and also does not exceed the allowable time limit specified in this Section.

Ensure that the demonstration concrete is mixed, delivered, placed, consolidated and cured in accordance with the proposed method and sequence. Produce the flowing concrete batches at slumps between 7.5 inches to 10.5 inches.

Perform inspection of the demonstration concrete during batching, delivery, placement and post placement. During placement, ensure that the concrete batches meet all plastic property requirements of the specifications and maintain their cohesive nature without excessive bleeding, segregation, or abnormal retardation.

Dispose of concrete produced for demonstration purposes at no expense to the Department. Subject to the Engineer's approval, the Contractor may incorporate this concrete into non-reinforced concrete items and may be included for payment, provided it meets Contract requirements for slump, entrained air, and strength.

After removal of the forms, perform the post-placement inspection of the in-place concrete. Observe for any signs of honeycombs, cracks, aggregate segregation or any other surface defects and ensure that the hardened concrete is free from these deficiencies. The Engineer may require saw cutting of the mock-up products to verify the uniform distribution of the aggregates within the saw cut surfaces and around the reinforcing steel and prestressing strands. The Engineer will require saw cutting of the demonstration mock-up products for plants that are demonstrating the use of the flowing concrete for the first time. Obtain core samples from different locations of mock-up products to inspect the aggregate distribution in each sample and compare it with the aggregate distribution of other core samples. Perform surface resistivity tests on the core samples or test cylinders at 28 days.

Submit the results of the laboratory trial batch tests and field demonstration of verified test data and inspection reports to the Engineer, along with certification stating that the results of the laboratory trial batch tests and field demonstration tests indicate that the proposed concrete mix design meets the requirements of the specifications. For the proposed mix design, state the anticipated maximum time limit between the batching and when the concrete of each batch is deposited during the production.

Upon the review and verification of the laboratory trial batch, field demonstration test data, inspection reports and contractor's certification statement, the Department will approve the proposed mix design. The Department may approve proposed flowing concrete mixes, centrally mixed at the placement site,

without the production of demonstration batches, provided that the proposed mix meets the following two criteria:

- (1) A previously approved flowing concrete mix of the same class has demonstrated satisfactory performance under the proposed job placing conditions with a minimum of fifteen consecutive Department acceptance tests, which met all plastic and hardened concrete test requirements.
- (2) The cementitious materials and chemical admixtures, including the flowing concrete HRWR admixture, used in the proposed mix are the same materials from the same source used in the previously approved mix, (1) above.

Do not produce or place concrete until the design mixes have been approved.

346-4 Composition of Concrete.

346-4.1 Master Proportion Table: Proportion the materials used to produce the various classes of concrete in accordance with Table 3:

TABLE 3		
Class of Concrete	Minimum Total Cementitious Materials Content pounds per cubic yard	Maximum Water to Cementitious Materials Ratio pounds per pounds*
I	470	0.53
I (Pavement)	470	0.50
II	470	0.53
II (Bridge Deck)	611	0.44
III	611	0.44
III (Seal)	611	0.53
IV	658	0.41**
IV (Drilled Shaft)	658	0.41
V (Special)	752	0.37**
V	752	0.37**
VI	752	0.37**

*The calculation of the water to cementitious materials ratio (w/cm) is based on the total cementitious material including cement and any supplemental cementitious materials that are used in the mix.
 **When the use of silica fume or metakaolin is required, the maximum water to cementitious material ratio will be 0.35. When the use of ultrafine fly ash is required, the maximum water to cementitious material ratio will be 0.30.

346-4.2 Chloride Content Limits for Concrete Construction:

346-4.2.1 General: Use the following maximum chloride content limits for the concrete application and/or exposure environment shown:

Application/Exposure Environment		Maximum Allowable Chloride Content, pounds per cubic yard
Non Reinforced Concrete		No Test Needed
Reinforced Concrete	Slightly Aggressive Environment	0.70
	Moderately or Extremely Aggressive Environment	0.40
Prestressed Concrete		0.40

346-4.2.2 Control Level for Corrective Action: If chloride test results exceed the limits of Table 4, suspend concrete placement immediately for every mix design represented by the failing test results, until corrective measures are made. Perform an engineering analysis to demonstrate that the material meets the intended service life of the structure on all concrete represented by the failing chloride test results. Supply this information within 30 business days of the failing test results from a Professional Engineer, registered in the State of Florida and knowledgeable in the areas of corrosion and corrosion control.

346-5 Sampling and Testing Methods.

Perform concrete sampling and testing in accordance with the following methods:

Description	Method
Slump of Hydraulic Cement Concrete	ASTM C 143
Air Content of Freshly Mixed Concrete by the Pressure Method*	ASTM C 231
Air Content of Freshly Mixed Concrete by the Volumetric Method*	ASTM C 173
Making and Curing Test Specimens in the Field**	ASTM C 31
Compressive Strength of Cylindrical Concrete Specimens***	ASTM C 39
Obtaining and Testing Drilled Core and Sawed Beams of Concrete	ASTM C 42
Initial Sampling of Concrete from Revolving Drum Truck Mixers or Agitators	FM 5-501
Low Levels of Chloride in Concrete and Raw Materials	FM 5-516
Density (Unit Weight), Yield and Air Content (Gravimetric) of Concrete	ASTM C 138
Temperature of Freshly Mixed Portland Cement Concrete	ASTM C 1064
Sampling Freshly Mixed Concrete****	ASTM C 172
Static Segregation of Self Consolidating Concrete using Column Techniques	ASTM C 1610
Slump Flow of Self Consolidating Concrete	ASTM C 1611
Passing Ability of Self Consolidating Concrete by J-Ring	ASTM C 1621
Concrete Resistivity as an Electrical Indicator of its Permeability	FM 5-578

*Use the same type of meter for QC tests as the Department uses for Verification testing. When using pressure type meters, use an aggregate correction factor determined by the concrete producer for each mix design to be tested. Record and certify test results for correction factors for each type of aggregate at the concrete production facility.

** Provide curing facilities that have the capacity to store all QC, Verification, "hold" and Independent Verification cylinders simultaneously for the initial curing.

***The Verification technician will use the same size cylinders as the Quality Control technician.

**** Take the test sample from the middle portion of the batch in lieu of collecting and compositing samples from two or more portions, as described in ASTM C 172.

346-6 Control of Quality.

346-6.1 General: Develop a Quality Control Plan (QCP) as specified in Section 105. Meet the requirements of the approved QCP and Contract Documents. Ensure the QCP includes the necessary requirements to control the quality of the concrete.

Perform QC activities to ensure materials, methods, techniques, personnel, procedures and processes utilized during production meet the specified requirements. For precast/prestressed operations, ensure that the QC testing is performed by the producer.

Accept the responsibility for QC inspections on all phases of work. Ensure all materials and workmanship incorporated into the project meet the requirements of the Contract Documents.

Ensure the QCP includes any anticipated requirements for adjusting and controlling the concrete at the placement site. Include the testing procedures that will be implemented to control the quality of the concrete and ensure that concrete placed is within the tolerance range. Also, include provisions for the addition of water to concrete delivered to the placement site at designated level areas, to ensure the allowable amount of water stated on the concrete delivery ticket is correct and the maximum water to cementitious materials ratio on the approved design mix is not exceeded. Ensure the anticipated ranges of jobsite water additions are described and the proposed methods of measuring water for concrete adjustments are included.

Failure to meet the requirements of this Specification or the QCP will automatically void the concrete portion of the QCP. To obtain QCP re-approval, implement corrective actions as approved by the Engineer. The Engineer may allow the Contractor to continue any ongoing concrete placement but the Engineer will not accept concrete for any new placement until the QCP re-approval is given by the Engineer.

346-6.2 Concrete Design Mix: Provide concrete that has been produced in accordance with a Department approved design mix, in a uniform mass free from balls and lumps.

For slump target values in excess of 6 inches or self-consolidating concrete, utilize a grate over the conveyance equipment to capture any lumps or balls that may be present in the mix. The grate must cover the entire opening of the conveyance equipment and have an opening that is a maximum of 2 1/2 inches in any one direction. Remove the lumps or balls from the grate and discard them. Discharge the concrete in a manner satisfactory to the Engineer. Perform demonstration batches to ensure complete and thorough placements in complex elements, when requested by the Engineer.

Do not place concretes of different compositions such that the plastic concretes may combine, except where the plans require concrete both with and without silica fume, ultrafine fly ash, metakaolin or

calcium nitrite in a continuous placement. Produce these concretes using separate design mixes. For example, designate the mix with calcium nitrite as the original mix and the mix without calcium nitrite as the redesigned mix. Ensure that both mixes contain the same cement, fly ash or slag, coarse and fine aggregates and compatible admixtures. Submit both mixes for approval as separate mix designs, both meeting all requirements of this Section. Ensure that the redesigned mix exhibits plastic and hardened qualities which are additionally approved by the Engineer as suitable for placement with the original mix. The Engineer will approve the redesigned mix for commingling with the original mix and for a specific project application only. Alternately, place a construction joint at the location of the change in concretes.

346-6.3 Delivery Certification: Ensure that an electronic delivery ticket is furnished with each batch of concrete before unloading at the placement site. The delivery ticket may be proprietary software or in the form of an electronic spreadsheet, but shall be printed. Ensure that the materials and quantities incorporated into the batch of concrete are printed on the delivery ticket. Include the following information on the Delivery Ticket:

- (1) Arrival time at jobsite,
- (2) Time that concrete mix has been completely discharged,
- (3) Number of revolutions upon arrival at the jobsite,
- (4) Total gallons of water added at the jobsite,
- (5) Additional mixing revolutions when water is added,
- (6) Total number of revolutions.

Items 3 through 6 do not apply to non-agitating concrete transporting vehicles.

Ensure the batcher responsible for production of the batch of concrete signs the delivery ticket, certifying the batch of concrete was produced in accordance with the Contract Documents.

Sign the delivery ticket certifying that the design mix maximum specified water to cementitious materials ratio was not exceeded due to any jobsite adjustments to the batch of concrete, and that the batch of concrete was delivered and placed in accordance with the Contract Documents.

346-6.4 Plastic Property Tolerances: Do not place concrete with a slump more than plus or minus 1.5 inches from the target slump value specified in Table 2.

Reject concrete with slump or air content that does not fall within the specified tolerances and immediately notify the concrete production facility that an adjustment of the concrete mixture is required. If a load does not fall within the tolerances, test each subsequent load and the first adjusted load. If failing concrete is not rejected or adjustments are not implemented, the Engineer may reject the concrete and terminate further production until the corrections are implemented.

Do not allow concrete to remain in a transporting vehicle to reduce slump. Water may be added only upon arrival of the concrete to the jobsite and not thereafter.

346-7 Mixing and Delivering Concrete.

346-7.1 General Requirements: Operate all concrete mixers at speeds and volumes per the manufacturer's design or recommendation as stipulated on the mixer rating plate.

346-7.2 Transit Truck Mixing: When water is added at the jobsite, mix the concrete 30 additional drum mixing revolutions. Do not add water after the total number of drum mixing revolutions exceeds 130, do not make additional mix adjustments. Discharge all concrete from truck mixers before total drum

revolutions exceed 300. Seek approval from the Engineer prior to using a central mixer and depositing the batch into a truck mixer.

346-7.2.1 Transit Time: Ensure compliance with Table 6 between the initial introduction of water into the mix and completely discharging all of the concrete from the truck:

TABLE 6	
Maximum Allowable Time	
Non-Agitator Trucks	Agitator Trucks
45 minutes	60 minutes
75 minutes*	90 minutes*
*When a water-reducing and retarding admixture (Type D, Type G or Type II) is used.	

346-7.2.2 Placement Time: All the concrete in a load must be in its final placement position a maximum of 15 minutes after the transit time has expired unless a time extension is approved in advance by the Engineer.

346-7.3 On-site Batching and Mixing: Include provisions in the QCP for the mixing at the site. Use a mixer of sufficient capacity to prevent delays that may be detrimental to the quality of the work. Ensure that the accuracy of batching equipment is in accordance with requirements of this Section.

346-7.4 Concreting in Cold Weather: Do not mix or place concrete when the air temperature is below 45°F. Protect the fresh concrete from freezing in accordance with Section 400. The requirements of concreting in cold weather are not applicable to precast concrete mixing and placement operations occurring in a temperature controlled environment.

346-7.5 Concreting in Hot Weather: Hot weather concreting is defined as the production, placing and curing of concrete when the concrete temperature at placing exceeds 86°F but is less than 100°F.

Unless the specified hot weather concreting measures are in effect, reject concrete exceeding 86°F at the time of placement. Regardless of special measures taken, reject concrete exceeding 100°F. Predict the concrete temperatures at placement time and implement hot weather measures to avoid production shutdown.

346-7.6 Adding Water to Concrete at the Placement Site: Perform an initial slump test before the addition of water at the jobsite. If the slump, as delivered, is outside the tolerance range, reject the load. If the slump is within the tolerance range, that load may be adjusted by adding water provided the addition of water does not exceed the water to cementitious materials ratio as defined by the mix design. After adding water, perform a slump test to confirm the concrete is within the slump tolerance range. If an adjustment is made at the concrete production facility, perform a slump test on the next load to ensure the concrete is within the slump tolerance range. Do not place concrete represented by slump test results outside of the tolerance range. Include water missing from the water storage tanks upon arrival at the project site in the jobsite water added.

346-7.7 Sample Location: Obtain acceptance samples from the point of final placement. Describe in the QCP the method to sample the plastic concrete at the point of final placement.

Where concrete buckets are used to discharge concrete directly to the point of final placement or into the

hopper of a tremie pipe, samples will be obtained from the discharge of the bucket. When the concrete is discharged directly from the mixer into the bucket and the bucket is discharged within 20 minutes, samples may be obtained from the discharge of the mixer.

Where conveyor belts, troughs, pumps, or chutes are used to transport concrete directly to the point of final placement or into the hopper of a tremie pipe, samples will be obtained from the discharge end of the entire conveyor belt, trough, pump, or chute system.

Where concrete is placed in a drilled shaft or other element using a tremie pipe and a concrete pump, samples will be obtained from the discharge of the pump line at the location of the tremie hopper. For all other placement methods, prior to each placement, obtain Department approval for sampling at the discharge of the mixer in lieu of sampling at the point of final placement. Describe the sampling correlation procedure in the QCP. Once the comparative sampling correlation is approved by the Engineer, apply this correlation to the plastic properties tolerances for samples obtained from the discharge of mixer.

Where a concrete pump is used to deposit concrete directly into a drilled shaft which is a wet excavation without the use of a tremie, or other applications as approved by the Engineer, ensure the discharge end of the pump line remains immersed in the concrete at all times after starting concrete placement.

346-8 Plastic Concrete Sampling and Testing.

QC tests include air content, temperature, slump, and preparing compressive strength cylinders for testing at later dates. In addition, calculate the water to cementitious materials ratio in accordance with FM 5-501 for compliance to the approved mix design.

Ensure that each truck has a rating plate and a valid mixer identification card issued by the Department. Ensure that the revolution counter on the mixer is working properly, and calibration of the water dispenser has been performed within the last twelve months. Reject any concrete batches that are delivered in trucks that do not have mixer identification cards. Remove the mixer identification card when a truck mixer is discovered to be in noncompliance and the mixer deficiencies cannot be repaired immediately. When the mixer identification card is removed for noncompliance, make note of the deficiency or deficiencies found, and forward the card to the District Materials and Research Engineer who has Producer QC Plan acceptance authority.

Perform plastic concrete tests on the initial delivery of each concrete design mix each day. Ensure QC technicians meeting the requirements of Section 105 are present and performing tests throughout the placement operation. Ensure one technician is present and performing tests throughout the placement operation at each placement site. If a project has multiple concrete placements at the same time, identify the number of technicians in the Quality Control Plan to ensure minimum sampling and testing frequencies are met. Ensure that the equipment used for delivery, placement and finishing meets the requirements of this Specification.

When a truck designated for QC testing arrives at the discharge site, a subsequent truck may also discharge once a representative sample has been collected from the QC truck and while awaiting the results of QC testing. Reject non-complying loads at the jobsite. Ensure that corrections are made on subsequent loads. Immediately cease concrete discharge of all trucks if the QC truck has failing test. Perform plastic properties tests on all trucks prior to the first corrected truck and the corrected truck. When more than one truck is discharging into a pump simultaneously, only the truck designated for QC testing may discharge into the pump to obtain a representative sample of concrete from the QC truck only.

Furnish sufficient concrete of each design mix as required by the Engineer for verification testing. When the Engineer's verification test results do not compare with the QC plastic properties test results, within the limits defined by the Independent Assurance (IA) checklist comparison criteria, located in Materials Manual Chapter 5, disposition of the concrete will be at the option of the Contractor.

On concrete placements consisting of only one load of concrete, perform initial sampling and testing in accordance with this Section. The acceptance sample and plastic properties tests may be taken from the initial portion of the load.

If any of the QC plastic properties tests fail, reject the remainder of that load, and any other loads that have begun discharging, terminate the LOT and notify the Engineer. Make cylinders representing that LOT from the same sample of concrete.

Following termination of a LOT, obtain samples from a new load, and perform plastic properties tests until such time as the water to cementitious materials ratio, air content, temperature and slump comply with the Specification requirements. Initiate a new LOT once the testing indicates compliance with Specification requirements.

Suspend production when any five loads in two days of production of the same design mix are outside the specified tolerances. Make the necessary revisions to concrete operations and increase the frequency of QC testing in the QCP to bring the concrete within allowable tolerances. Obtain the Engineer's approval of the revisions before resuming production. After production resumes, obtain the Engineer's approval before returning to the normal frequency of QC testing.

If concrete placement stops for more than 90 minutes, perform initial plastic properties testing on the next batch and continue the LOT. Cylinders cast for that LOT will represent the entire LOT.

When the Department performs Independent Verification, the Contractor may perform the same tests on the concrete at the same time. The Department will compare results based on the Independent Assurance Checklist tolerances.

When the Department's Independent Verification test results do not meet the requirements of this Section, the Engineer may require the Contractor to revise the QCP.

346-9 Acceptance Sampling and Testing.

346-9.1 General: Perform plastic properties tests in accordance with 346-8 and cast a set of three QC cylinders, for all structural concrete incorporated into the project. Take these acceptance samples randomly as determined by a random number generator (acceptable to the Department). The Department will independently perform verification plastic properties tests and cast a set of verification cylinders. The verification cylinders will be the same size cylinder selected by the Contractor, from a separate sample from the same load of concrete as the Contractor's QC sample.

The Department may perform inspections in lieu of plastic properties tests of the precast plants producing Class I and II concrete, except for Incidental Precast plants.

For each set of QC cylinders verified by the Department, cast one additional cylinder from the same sample, and identify it as the QC "hold" cylinder. The Department will also cast one additional "hold" cylinder from each Verification sample. All cylinders will be clearly identified as outlined in the Sample/Lot Numbering System instructions located on the State Materials Office website. Deliver the QC samples, including the QC "hold" cylinder to the final curing facility in accordance with ASTM C 31. At

this same time, the Department will deliver the Verification samples, including the Verification “hold” cylinder, to their final curing facility.

Test the QC laboratory cured samples for compressive strength at the age of 28 days, or any other specified age, in a laboratory meeting and maintaining at all times the qualification requirements listed in Section 105.

The QC testing laboratory will input the compressive strength test results into the Department’s sample tracking database within 24 hours. When the QC testing laboratory cannot input the compressive strength test results into the Department’s sample tracking database within 24 hours, the QC testing laboratory will notify the Verification testing laboratory within 24 hours of testing the cylinder and provide the Verification testing laboratory the compressive strength test results. Ensure the compressive strength results are input into the Department’s sample tracking database within 72 hours of determining the compressive strength of the cylinders.

The Department will compare the Verification sample results with the corresponding QC sample results. In the event that one set of compressive strength data for a set of cylinders falls outside the range of the other set of cylinders, use the lower Range of Average Compressive Strength to determine the comparison criteria. Based on this comparison, the Department will determine if the Comparison Criteria as shown in Table 7 has been met. When the difference between QC and Verification is less than or equal to the Comparison Criteria, the QC data is verified. When the difference between QC and Verification data exceeds the Comparison Criteria, the Engineer will initiate the resolution procedure.

Range of Average Compressive Strength	Comparison Criteria
Less than 3500 psi	420 psi
3,501 – 4,500 psi	590 psi
4,501 – 6,500 psi	910 psi
6,501 – 8,500 psi	1,275 psi
Greater than 8,500 psi	1,360 psi

346-9.2 Sampling Frequency:

As a minimum, sample and test concrete of each design mix for water to cementitious materials ratio, air content, temperature, slump and compressive strength once per LOT as defined by Table 8. When a mix design is used for a different application, the LOT is defined by the application. When more than one concrete production facility is used for the same mix design, describe the method of sampling, testing and LOT numbering in the QC Plan. The Engineer will randomly verify one of every four consecutive LOTs of each design mix based on a random number generator. The Department may perform Independent Verification testing to verify compliance with specification requirements. All QC activities, calculations, and inspections will be randomly confirmed by the Department.

TABLE 8	
Class Concrete*	Maximum LOT Size
I	one day's production
I (Pavement)	2,000 square yards, or one day's production, whichever is less
II, II (Bridge Deck), III, IV, V (Special), V, VI	50 cubic yards, or one day's production, whichever is less
IV (Drilled Shaft)	50 cubic yards, or two hours between the end of one placement and the start of the next placement, whichever is less
III (Seal)	Each Seal placement
*For any class of concrete used for roadway barrier wall, the lot size is defined as 100 cubic yards, or one day's production, whichever is less.	

346-9.2.1 Reduced Frequency for Acceptance Tests: The LOT size may represent 100 cubic yards when produced at the same mix design at the same concrete production facility for the same prime contractor and subcontractor on a given Contract. Submit test results indicating the average compressive strength is greater than two standard deviations above the specified minimum strength for that class of concrete. Base calculations on a minimum of ten consecutive strength test results for a Class IV or higher; or a minimum of five consecutive strength results for a Class III or lower.

The average of the consecutive compressive strength test results, based on the class of concrete, can be established using historical data from a previous Department project. The tests from the previous Department project must be within the last 60 calendar days or may also be established by a succession of samples on the current project. Only one sample can be taken from each LOT. Test data must be from a laboratory meeting the requirements of Section 105. Obtain Department approval before beginning reduced frequency LOT's.

If at any time a strength test is not verified or the average strength of the previous ten or five consecutive samples based on the class of concrete from the same mix design and the same production facility is less than the specified minimum plus two standard deviations, return to the maximum production quantity represented by the LOT as defined in Table 8. Notify the Engineer that the maximum production rate is reinstated. In order to reinitiate reduced frequency, submit a new set of strength test results.

346-9.3 Strength Test Definition: The strength test of a LOT is defined as the average of the compressive strengths tests of three cylinders cast from the same sample of concrete from the LOT.

346-9.4 Acceptance of Concrete:

Ensure that the hardened concrete strength test results are obtained in accordance with 346-9.3. Do not discard a cylinder strength test result based on low strength (strength below the specified minimum strength as per the provisions of this Section).

When one of the three QC cylinders from a LOT is lost, missing, damaged or destroyed, determination of compressive strength will be made by averaging the remaining two cylinders. If more than one QC cylinder from a LOT is lost, missing, damaged or destroyed, the Contractor will core the structure at no

additional expense to the Department to determine the compressive strength. Acceptance of LOT may be based on verification data at the discretion of the Engineer. Obtain the approval of the Engineer to core, and of the core location prior to coring.

For each QC cylinder that is lost, missing, damaged or destroyed, payment for that LOT will be reduced by \$750.00 per 1,000 psi of the specified design strength [Example: loss of two Class IV (Drill Shaft) QC cylinders that has no verification data will require the element to be cored and a pay reduction will be assessed $(4,000 \text{ psi} / 1,000 \text{ psi}) \times \$750 \times 2 = \$6,000$]. This reduction will be in addition to any pay adjustment for low strength.

When QC compressive strength test results are not verified, the resolution procedure will be used to accept or reject the concrete. Maintain the “hold” cylinders until the verification of the compressive strength test results.

When QC test results are verified, the Engineer will accept the concrete based on QC test results. The Engineer will accept at full pay only LOTs of concrete represented by plastic property results which meet the requirements of the approved mix design and strength test results which equal or exceed the respective specified minimum strength.

346-9.5 Resolution Procedure: The Department may initiate an IA review of sampling and testing methods. The resolution procedure may consist of, but need not be limited to, a review of sampling and testing of fresh concrete, calculation of water to cementitious materials ratio, handling of cylinders, curing procedures and compressive strength testing. Core samples of the hardened concrete may be required. The Engineer will determine through the resolution procedure whether the QC strength test results or the verification strength test are deemed to be the most accurate. When the Engineer cannot determine which strength test results are the most accurate, the concrete represented by the four consecutive LOTs will be evaluated based on the QC data. The Engineer will inform the QC and the Verification lab within three calendar days of the acceptance compressive strength test to transport their “hold” cylinders to the resolution lab. The QC and Verification laboratories will transport their own hold cylinder to the resolution testing laboratory within 72 hours after the Engineer notifies the Contractor that a resolution is required. In addition, the Engineer will ensure that the QC and verification “hold” cylinders are tested within seven calendar days of the acceptance strength tests.

The resolution investigation will determine the strength test results for each of the four or less LOTs. When the QC strength test results are deemed to be the most accurate, the QC strength test results will represent the four or less consecutive LOTs and the Department will pay for the resolution testing and investigation. When the verification strength test results are deemed to be the most accurate, the Department will assess a \$1,000 pay reduction for the cost of the Resolution Investigation.

The results of the resolution procedure will be forwarded to the Contractor within five working days after completion of the investigation. If the Department finds deficiencies based on the Contractor’s QCP, the Engineer may suspend that part of the QCP. When the QC plan is suspended, submit corrective actions for approval to the Engineer. The Engineer may take up to five working days to review corrective actions to the QCP. The Engineer will not allow changes to contract time or completion dates. Incur all delay costs and other costs associated with QC plan suspension and re-approval.

346-9.6 Small Quantities of Concrete: When a project has a total plan quantity of less than 50 cubic yards, that concrete will be accepted based on the satisfactory compressive strength of the QC cylinders. Provide certification to the Engineer that the concrete was batched and placed in accordance with the Contract Documents. Submit a quality control plan for the concrete placement operation in accordance with Section 105. In addition, the Engineer may conduct Independent Verification (IV) testing as

identified in 346-9. Evaluate the concrete in accordance with 346-10 at the discretion of the Engineer.

346-10 Investigation of Low Strength Concrete for Structural Adequacy.

346-10.1 General: When a concrete acceptance strength test result falls more than 500 psi below the specified minimum strength and the Department determines that an investigation is necessary, make an investigation into the structural adequacy of the LOT of concrete represented by that acceptance strength test result at no additional expense to the Department. The Engineer may also require the Contractor to perform additional strength testing as necessary to determine structural adequacy of the concrete.

Furnish either a structural analysis performed by the Specialty Engineer to establish strength adequacy or drilled core samples as specified in 346-10.3 to determine the in- place strength of the LOT of concrete in question at no additional expense to the Department. Obtain the Engineer's approval before taking any core samples. When the concrete is deemed to have low strength, obtain and test the cores and report the data to the Engineer within 10 calendar days of the 28 day compressive strength tests. Core strength test results obtained from the structure will be accepted by both the Contractor and the Department as the in-place strength of the LOT of concrete in question. The core strength test results will be final and used in lieu of the cylinder strength test results for determination of structural adequacy and any pay adjustment. The Department will calculate the strength value to be the average of the compressive strengths of the three individual cores. This will be accepted as the actual measured value.

346-10.2 Determination of Structural Adequacy: If core strength test results are less than 500 psi below the specified minimum strength, consider the concrete represented by the cores structurally adequate. If the core strength test results are more than 500 psi below the specified minimum strength, the Department will consider the concrete represented by the cores structurally questionable. Submit a structural analysis performed by the Specialty Engineer. If the results of the structural analysis indicate adequate strength to serve its intended purpose with adequate durability, and is approved by the Department, the Contractor may leave the concrete in place subject to the requirements of 346-11, otherwise, remove and replace the LOT of concrete in question at no additional expense to the Department.

346-10.3 Coring for Determination of Structural Adequacy: Notify the Engineer 48 hours prior to taking core samples. The Engineer will select the size and location of the drilled cores so that the structure is not impaired and does not sustain permanent damage after repairing the core holes. Sample three undamaged cores taken from the same approximate location where the questionable concrete is represented by the low strength concrete test cylinders. Repair core holes after samples are taken.

346-10.4 Core Conditioning and Testing: Test the cores in accordance with ASTM C 42. Test the cores after obtaining the samples within seven calendar days.

346-11 Pay Adjustments for Low Strength Concrete.

346-11.1 General: Any LOT of concrete failing to meet the specified minimum strength as defined in 346-3, 346-9, 346-10 and satisfactorily meeting all other requirements of the Contract Documents, including structural adequacy, the Engineer will individually reduce the price of each low strength LOT in accordance with this Section.

346-11.2 Basis for Pay Adjustments: When an acceptance strength test result falls more than 500 psi below the specified minimum strength, core samples may be obtained in accordance with ASTM C 42 from the respective LOT of concrete represented by the low acceptance strength test result for

determining pay adjustments. A price adjustment will be applied to the certified invoice price the Contractor paid for the concrete or the precast product.

Do not core hardened concrete for determining pay adjustments when the 28 day acceptance cylinder strength test results are less than 500 psi below the specified minimum strength.

The results of strength tests of the drilled cores, subject to 346-11.5 and 346-11.6, will be used as the acceptance results and will be used in lieu of the cylinder strength test results for determining pay adjustments.

In precast operations, excluding prestressed, ensure that the producer submits acceptable core sample test results to the Engineer. The producer may elect to use the products in accordance with 346-11. Otherwise, replace the concrete in question at no additional cost to the Department. For prestressed concrete, core sample testing is not allowed for pay adjustment. The results of the cylinder strength tests will be used to determine material acceptance and pay adjustment.

346-11.3 Coring for Determination of Pay Adjustments: Obtain the cores in accordance with 346-10.3.

346-11.4 Core Conditioning and Testing: Test the cores in accordance with 346-10.4.

346-11.5 Core Strength Representing Equivalent 28 Day Strength: For cores tested no later than 42 calendar days after the concrete was cast, the Engineer will accept the core strengths obtained as representing the equivalent 28 day strength of the LOT of concrete in question. The Engineer will calculate the strength value to be the average of the compressive strengths of the three individual cores. The Engineer will accept this strength at its actual measured value.

346-11.6 Core Strength Adjustments: For cores tested later than 42 calendar days after the concrete was cast, the Engineer will establish the equivalency between 28 day strength and strength at ages after 42 calendar days. The Engineer will relate the strength at the actual test age to 28 day strength for the design mix represented by the cores using the following relationship:

346-11.6.1 Portland Cement Concrete without Pozzolan or Slag:

Equivalent 28 Day Strength, $f_c(28) = 1/F$ (Average Core Strength) x 100 where:

$$F = 4.4 + 39.1 (\ln x) - 3.1 (\ln x)^2 \text{ (Type I Cement)}$$

$$F = -17.8 + 46.3 (\ln x) - 3.3 (\ln x)^2 \text{ (Type III Cement)}$$

$$F = 48.5 + 19.4 (\ln x) - 1.4 (\ln x)^2 \text{ (Type II Cement)}$$

x = number of days since the concrete was placed

ln = natural log

346-11.6.2 Pozzolanic-Cement Concrete:

Equivalent 28 day compressive strength = $f_c(28)$, where:

$$f_c(28) = 0.490 \times f_c(t) \times e^{(8.31/t)^{0.276}}$$

(Type I Cement)

$$f_c (28) = 0.730 \times f_c(t) \times e^{(2.89/t)^{0.514}} \quad (\text{Type II Cement})$$

$$f_c (28) = 0.483 \times f_c(t) \times e^{(5.38/t)^{0.191}} \quad (\text{Type III Cement})$$

$f_c (t)$ = Average Core Strength at time t (psi)
t = time compressive strength was measured (days)

346-11.6.3 Slag-Cement Concrete:

Equivalent 28 day compressive strength = $f'_c (28)$, where:

$$f_c (28) = 0.794 \times f_c(t) \times e^{(7.06/t)^{1.6}} \quad (\text{Type I Cement})$$

$$f_c (28) = 0.730 \times f_c(t) \times e^{(6.02/t)^{0.747}} \quad (\text{Type II Cement})$$

$$f_c (28) = 0.826 \times f_c(t) \times e^{(2.36/t)^{0.672}} \quad (\text{Type III Cement})$$

$f'_c (t)$ = Average Core Strength at time t (psi)
t = time compressive strength was measured (days)

346-11.7 Calculating Pay Adjustments: The Engineer will determine payment reductions for low strength concrete accepted by the Department and represented by either cylinder or core strength test results below the specified minimum strength, in accordance with the following:

Reduction in Pay is equal to the reduction in percentage of concrete cylinder strength (specified minimum strength minus actual strength divided by specified minimum strength).

For the elements that payments are based on the per foot basis, the Engineer will adjust the price reduction from cubic yards basis to per foot basis, determine the total linear feet of the elements that are affected by low strength concrete samples and apply the adjusted price reduction accordingly.

346-12 Pay Reduction for Plastic Properties

A rejected load in accordance with 346-6.4 is defined as the entire quantity of concrete contained within a single ready mix truck or other single delivery vehicle regardless of what percentage of the load was placed. If concrete fails a plastic properties test and is thereby a rejected load but its placement continues after completion of a plastic properties test having a failing result, payment for the concrete will be reduced.

The pay reduction for cast-in-place concrete will be twice the invoice price per cubic yard of the quantity of concrete in the rejected load.

The pay reduction for placing a rejected load of concrete into a precast product will be applied to that percentage of the precast product that is composed of the concrete in the rejected load.

The percentage will be converted to a reduction factor which is a numerical value greater than zero but not greater than one. The precast product payment reduction will be twice the Contractor's billed price from

the Producer for the precast product multiplied by the reduction factor.

If the Engineer authorizes placement of the concrete, even though plastic properties require rejection, there will be no pay reduction based on plastic properties failures; however, any other pay reductions will apply.

Payment will be made under:

Pay Item 346-1 10" PCC Apron Per Square Yard (SY)

END OF SECTION 346

**SECTION 350
CEMENT CONCRETE PAVEMENT**

350-1 Description.

Construct Portland cement concrete pavement in one course, on a prepared subgrade. Use either the fixed-form or the slip-form method of construction. When reinforced cement concrete pavement is specified or required, use concrete reinforced with steel bars or steel fabric, in accordance with details shown in the Plans. The Engineer may require a demonstration of equipment and paving operations.

If any uncontrolled cracks appear during the life of the Contract, remove and replace the cracked concrete at no expense to the Department. Investigate and implement immediate effective solutions to eliminate further cracks, in consultation with, and subject to the approval of the Engineer.

Furnish the following information in the Quality Control Plan (QCP) as required in Section 105:

1. A detailed sequence and schedule of concrete placement operations including, but not limited to, width of pavement to be placed, proposed equipment, production rates, working hours, concrete hauling, and placement, curing, sawing, and sealing methods. Identify backup equipment and the procedures that will be followed in the case of a breakdown of equipment.
2. A method to ensure the proper placement of reinforcing steel, tie bars and dowel bars.
3. A traffic control plan that includes provisions for the placement and maintenance of barriers required to protect the pavement from traffic, for a minimum of 14 days after concrete placement.
4. Defined provisions for adequate lighting for all work done at night, including finishing, curing, and sawing joints.
5. A method for ensuring pavement thickness is met and a consolidation procedure is identified.
6. If forms are to be utilized define the material, dimensions, type, connections, and staking of the forms.
7. Define the procedure for the protection of the fresh concrete pavement from inclement weather.

350-2 Materials.

Meet the following requirements:

Concrete, Class I or Class I (Pavement)	Section 346
Grinding Concrete Pavement	Section 352
Curing Materials	Section 925
Embedded Items.....	Section 931
Joint Seal.....	Section 932

For concrete pavement placed using the slip-form method of construction, utilize Concrete Class I (Pavement). For concrete pavement placed by hand in constructed forms, utilize Concrete Class I or Concrete Class I (Pavement). LOT size for the use of either material shall be as stated in Section 346 for Concrete Class I (Pavement).

350-3 Equipment.

350-3.1 General: Ensure the equipment and tools that are to be used meet the following: The capability of handling materials and performing all parts of the work.

To be of such capacity that the paver operates continuously and at a constant rate of production, with starting and stopping held to a minimum.

When equipment operates on the side forms, use scraping devices to clean accumulations from the top of the forms and wheels.

The forms will be a rigid material and mortar tight. Ensure that the alignment and grade of all forms are in accordance with the contract documents, prior to the placing of concrete.

350-3.2 Slip-Form Paver: Provide a slip-form paver that is self-propelled and equipped to spread, strike-off, consolidate, screed, and float-finish the freshly placed concrete in one complete pass of the equipment, in such a manner that a minimum amount of hand-finishing will be necessary to provide a dense and homogeneous pavement. Ensure that the equipment is of such dimensions and arrangement as to cover the full width of the pavement strip being placed. Use equipment that is adjustable as to crown and superelevation and that can shape and compact the concrete into a dense and stable mass, to the required cross-section. Ensure that the crown adjustment is readily controllable for accuracy in crown transitions.

Operate the paver on tracks having sufficient contact area to prevent track slippage under load. Ensure that the length of ground contact per track and the arrangement of tracks are adequate to meet the straightedge and other riding-quality requirements specified.

Accomplish screeding by either: (1) oscillating screeds, (2) an extrusion device, or (3) a combination of both.

If necessary, in order to produce a pavement of the required cross-section and meeting the surface requirements, equip the slip-form paver with traveling side forms of sufficient dimension and strength and of proper shape to support the concrete laterally for a sufficient length of time during placing and finishing.

If using trailing forms, provide forms that are rigidly supported laterally.

Equip the slip-form paver with automatic guidance and grade controls which operate by sensing from a taut line set true to line and grade. Erect and maintain the taut line.

Automatic grade controls are not required on the paver when the tracks of the slip-form paver are operating on previously placed concrete pavement. The Engineer may waive the use of automatic grade controls on the paver when the entire width of the tracks of the slip-form paver are operating on a subgrade which has been consistently trimmed to a tolerance of 1/8 inch above or below true grade as established by the taut line set for that purpose.

350-3.3 Vibratory Units: Consolidate the concrete for the full width of the strip being placed with either surface pan type or internal type vibrators. Use a vibration method with sufficient intensity and duration to ensure complete consolidation of the concrete without causing segregation of the materials.

For the surface vibrators, use a frequency of not less than 3,500 impulses per minute. For internal type vibrators, use a frequency of not less than 5,000 impulses per minute for tube vibrators and not less than 7,000 impulses per minute for spud vibrators. When using spud-type internal vibrators adjacent to forms, either hand-operated or attached to spreaders or finishing machines, use a frequency of not less than 3,500 impulses per minute. Measure and record the frequency of internal vibrators in plastic concrete and submit data to the Engineer. Mount spud vibrators such that the free tip trails, and space spud vibrators at a maximum interval of 30 inches.

Provide an amplitude of vibration with spud vibrators that is sufficient for the vibration to be perceptible on the surface of the concrete along the entire width of the strip being placed. Measure and record the actual frequency of vibrations and submit data to the Engineer. Control all vibration by the forward movement of the spreader or finishing machine so that vibration automatically ceases when stopping the forward movement of the spreader.

350-3.4 Device for Application of Membrane Curing Compound: Provide equipment for applying membrane curing compound that is self-propelled and capable of uniformly applying the curing compound at the specified rate. Use equipment that continuously stirs the curing compound, by effective mechanical means, and that thoroughly atomizes the curing compound during the spraying operation so that the finished surface of the fresh concrete will not be marred. Cover the entire surface of the pavement and, with slip-form type paving, the vertical faces by a single pass of the machine. Only use spray nozzles that are equipped with appropriate wind guards to ensure uniform application.

Power-spray equipment may be used to apply curing compound to areas where it is impracticable to operate the self-propelled equipment.

350-3.5 Equipment for Paving Small or Narrow Areas: For variable width areas, other than mainline, ramps, and shoulders, the Engineer will not require the full paving train as specified for the standard run of paving. Use such equipment that is approved by the Engineer.

350-3.6 Hand Finishing Tools: Provide straightedges that have a blade length of 10 feet. Use long-handled floats that have flat blades, approximately 4 feet long by 5 to 8 inches wide, and that are designed so as to remain straight and true. Use a handle for both types of tool with a length that exceeds 1/2 the width of the strip being placed by 3 feet.

350-4 Subgrade Preparation.

Keep construction of the subgrade completed for a distance of at least 500 feet ahead of the paving operation. Maintain the finished subgrade in a smooth, compact condition, and restore any areas which are disturbed prior to placing the concrete. Do not place concrete on a frozen subgrade.

Ensure that the subgrade is within two percent of the optimum moisture content while placing the concrete. Uniformly apply water ahead of the paving operations, as directed by the Engineer.

Do not allow vehicles to travel on the prepared subgrade between the subgrade trimming machine and the paving operations unless specifically authorized.

Accurately trim the subgrade to the required elevation. Trim high areas to proper elevation. Fill low areas with suitable material, compacted to the specified density, or with concrete placed integrally with the pavement. When slip-form paving, include in the width to be trimmed the areas on which the tracks of the paver will operate.

Remove material planed from the subgrade before placing any concrete. The Engineer may waive the use of the planer for small or isolated areas or any areas where its use would be impracticable.

350-5 Setting Forms.

350-5.1 General: Accurately set the forms to line and grade and such that they rest firmly, throughout their entire length, upon the subgrade surface. Join forms neatly and tightly, and brace them to resist the pressure of the equipment operating on the forms. Obtain the Engineer's approval of the alignment and grade of all forms before and immediately prior to the placing of concrete.

Fill any subgrade that is below the established grade at the form line to grade with granular material, in lifts of 1/2 inch or less, for a distance of 18 inches on each side of the pavement edge, and thoroughly compact the material. As an exception, when placing forms on a cement-treated subgrade, the Contractor may use wedging, provided that the wedging system used adequately supports the forms without causing detrimental deflection under the weight of the paving equipment.

350-5.2 Tamping: When placing forms on other than a cement-treated subgrade, adequately tamp the materials below and adjacent to the forms with form-tamping machines.

350-5.3 Advance Preparation of Forms: Keep sufficient forms on hand at all times, and set forms so that at least 500 feet of forms on each side of the roadway will be accurately set, and maintained true to line and grade, in advance of the point where concrete is being placed.

Provide sufficient forms so that it is not necessary to remove them in less than 12 hours after placing the concrete.

350-5.4 Cleaning Forms: Thoroughly clean the forms after each use and before placing concrete against them. Apply a release agent in accordance with the manufacturer's recommendations.

350-6 Protection from Weather.

Meet the requirements of 400-7.1 when placing concrete. When rain appears imminent, stop all paving operations, and cover the surface of the unhardened concrete with the protective covering.

350-7 Placement of Reinforcement.

350-7.1 General: Where the Plans call for reinforced concrete pavement, place the steel reinforcement in the pavement slab in accordance with the details shown in the Plans. At the time of the concrete placement, ensure that the reinforcing steel is free from any of the following which could impair bonding of the steel with the concrete: dirt, oil, paint, grease, mill scale, and any loose or thick rust. Place the reinforcement as provided below.

350-7.2 Fabric: Place welded wire reinforcement at right angles to the centerline of the pavement and accurately to the position and location shown in the Plans. Lap adjacent sheets of welded wire reinforcement not less than 6 inches. Make the laps only in the longitudinal members.

350-7.3 Bars: Place bar reinforcement as shown in the Plans. Securely wire together transverse and longitudinal bars at their intersections. Lap splices not less than 20 times the nominal diameter of the bar, and only in the longitudinal members.

350-8 Placing Concrete.

350-8.1 Distribution: Distribute the concrete on the subgrade to such depth that, when it is consolidated and finished, the slab thickness required by the Plans will be obtained at all points. The surface will at no point be below the grade specified for the finished surface. Place the concrete on the subgrade in a manner which will require as little rehandling as possible.

Place concrete as near to expansion and contraction joint assemblies as possible without disturbing them. Ensure that workers do not walk in the freshly placed concrete with their boots or shoes coated with earth or other deleterious substances.

350-8.2 Use of Spreader: Place concrete on the subgrade by an approved spreading device. Do not place concrete from the discharge bucket or hopper onto an assembly without centering the bucket or hopper directly over the assembly.

A spreader is not required in areas where the width of slab varies, intersections, and small or isolated areas where it would be impractical to use a spreader. Perform the necessary hand spreading with shovels (not with rakes or hoes).

350-8.3 Placement Widths: The Contractor may construct the pavement either in lanes as determined by the longitudinal joints shown in the Plans, or for the full width in one operation. Construct the pavement to the full width of the lane or slab in a single construction operation. When constructing pavement in separate lanes, do not deviate the junction line from the true line shown in the Plans by more than 1/2 inch at any point. Tool the edges of the junction to the radius shown in the Plans.

When constructing pavement in separate lanes, place the lanes adjacent to the low edge of the pavement, as shown on the typical section, first.

350-8.4 Consolidation Along Forms and Joints: Thoroughly consolidate concrete against and along the faces of all forms, and along the full length on both sides of all joint assemblies, by means of hand-operated, spud-type vibrators. Do not allow vibrators to come in contact with a joint assembly, reinforcement, the subgrade or a side form.

350-8.5 Slip-Form Paver: When placing concrete with a slip-form paver, operate the paver with a continuous forward movement. If for any reason it is necessary to stop the forward movement of the paver, immediately stop operation of the vibrating or tamping elements. Do not apply tractive force to the paving machine except that which is controlled from the machine. In case of an emergency, have available for use at the project site at least 100 feet of forms.

Do not insert steel tie-bars into the unsupported side of the freshly formed slab.

The Contractor may place tie-bars into position prior to extrusion from the paver by insertion through the forms, by insertion through a temporary support form placed against the form slab, or by other means approved by the Engineer. Use a method that results in placement of the tie-bars at the specified locations with no damage or disruption of the concrete.

350-9 Striking-off, Consolidating, and Finishing Concrete.

350-9.1 General Requirements: Immediately after placing the concrete, strike-off, consolidate, and finish it to produce a finished pavement in accordance with the cross-section, width, and surface finish required by the Contract Documents. Perform the sequence of operations as follows: strike-off; vibratory consolidation; screeding; floating; removal of laitance; straightedging; and final surface finish. Except as specified, perform strike-off, consolidation, screeding, and floating by the machine method.

Use equipment that is fully and accurately adjustable to produce a pavement meeting project requirements. Use equipment that is capable of operating in a consistent and smooth manner under all conditions of use.

As soon as possible after screeding while the concrete is plastic, correct all flaws such as cavities, blemishes, marks, or scratches that will not be removed by planing. .

Provide a concrete surface true to grade, cross slope and superelevation, and free of irregularities. If the Engineer permits adding water to assist the finishing operations, apply water as a fog spray by means of approved spray equipment.

350-9.2 Machine Method: Operate the machine over each area of pavement as few times and at such intervals as is necessary to give proper consolidation and to leave a surface of uniform texture. Avoid excessive operation over a particular area.

Perform strike-off, consolidation, and finishing in a manner such as to avoid damage to, or misalignment of, joint assemblies, reinforcing steel, dowels, and other embedded items. Smooth the surface of the concrete and remove the excess mortar from the surface. Carry a small amount of mortar ahead of the float device as it moves on the surface of the concrete. Operate the machine over the surface of the concrete as many times as required to obtain an acceptable surface, meeting the requirements specified herein. Discard excess mortar beyond the edge of the slab.

350-9.3 Hand Methods:

350-9.3.1 Conditions under which Allowed: Use hand methods in areas of narrow width or irregular dimensions, where operation of mechanical equipment is impracticable.

350-9.3.2 Strike-off and Screeding: Use a portable screed of an approved design, constructed either of metal or of other suitable material shod with metal, to strike-off and screed the concrete. Use a screed that is sufficiently rigid to retain its shape and is at least 2 feet longer than the maximum width of the strip to be screeded.

350-9.3.3 Consolidation: Use hand-operated spud-type vibrators to consolidate.

350-9.3.4 Floating: Use long-handled floats to float the concrete. Take the necessary care to avoid creating depressions or ridges during this operation.

350-9.4 Work Bridges: Provide work bridges or other devices necessary for access to the pavement surface for the purpose of inspection, finishing, straightedging, and performing corrective work.

350-10 Final Finish.

350-10.1 Finishing: As the water sheen disappears from the surface of the pavement and just before the concrete achieves its initial set, drag a seamless length of damp burlap that extends the full width of the strip of the constructed pavement, longitudinally along the surface to produce a uniform gritty texture.

Use a burlap drag that consists of two layers of medium weight burlap with the trailing edge of the lower layer extending approximately 2 inches behind the upper layer. Support the burlap drag in a manner so that a length of at least 3 feet of burlap is in contact with the pavement.

Except in areas where using hand methods to construct the pavement, support the lead end of the burlap drag by a traveling bridge. Maintain the drag clean and free from encrusted mortar. Replace the burlap with new material as necessary.

350-10.2 Edging: After applying the final finish, but before the concrete has become nonplastic, carefully round the edges to a 1/4 inch radius on each side of transverse expansion joints and construction joints and along any structure extending into the pavement. Produce a well-defined and continuous radius, and obtain a smooth, dense mortar finish. Completely remove all concrete from the top of the joint filler.

Check all joints with a straightedge before the concrete has become nonplastic, and, if one side of the joint is higher than the other or the entire joint is higher or lower than the adjacent slabs, make corrections as necessary.

350-11 Curing.

350-11.1 General: After completing the finishing operations and as soon as the concrete has hardened sufficiently to not mar the surface, cover and cure the entire surface and, when the slip-form method is used, cover and cure the edges of the newly placed concrete in accordance with one or more of the methods described below. In cases where curing requires the use of water, ensure that curing has prior right to use all water supplies. If the Contractor fails to provide sufficient curing materials to adequately cure the concrete in place in a timely manner, that portion of the concrete pavement section addressed in the QCP will be suspended. Do not leave the concrete exposed for a period in excess of 30 minutes between stages of curing or during the curing period.

Continuously cure the freshly placed concrete for a period of 72 hours, exclusive of any periods when the temperature of the surface of the concrete falls below 50°F.

350-11.2 White-Pigmented Curing Compound: Under this method, uniformly apply white-pigmented curing compound to the surfaces to be cured, in a single coat, continuous film, at the minimum rate of 1 gallon to every 200 ft², by a mechanical sprayer.

At the time of use, thoroughly mix the compound in accordance with the manufacturer's recommendation.

Do not apply curing compound during periods of rainfall. Do not apply curing compound to the inside faces of joints to be sealed. Should the film become damaged from any cause within the required curing period, repair the damaged portions immediately with additional compound. If using side forms, upon their removal, immediately coat the sides of the slabs exposed to provide a curing treatment equal to that provided for the surface.

350-11.3 Burlap Mats: Thoroughly saturate the mats with water before placing them. Use mats of such dimensions that as laid they extend to at least 2 feet beyond the edges of the strip of concrete placed. Place and weigh down the mats throughout the curing period to ensure contact with the surface being cured. Maintain the mats fully moist and in position for the entire portion of the required curing period.

350-11.4 Removal of Forms: Do not remove forms from freshly placed concrete for at least 12 hours after placement. Remove forms carefully so as to avoid damage to the pavement. After removing the forms, immediately cure the sides of the slab in the same manner as the surface of the pavement.

350-12 Joints.

350-12.1 General: Construct joints at the locations and in accordance with the details shown in the Design Standards, Index Nos. 305 and 306 and the Contract Documents.

350-12.2 Longitudinal Joints:

350-12.2.1 Longitudinal Construction Joints: Where the pavement is poured in strips less than the full width of the pavement, construct longitudinal construction joints in accordance with the details shown in the Plans.

350-12.2.2 Longitudinal Lane-tie Joints: Construct longitudinal lane-tie joints within the limits of a strip of pavement, in accordance with the details shown in the Plans. Construct the plane of weakness by sawing a groove in the hardened concrete. Complete sawing as soon as possible but in no case longer than 72 hours after placing the concrete.

350-12.2.3 Tie Bars and Bolt Assemblies: Place deformed steel tie bars or tie bolt assemblies at the required depth, parallel to the finished surface, at right angles to the joint and at the uniform spacing specified or required in the Plans. Place them in the plastic concrete using approved equipment, or rigidly support them on the subgrade by approved devices capable of preventing displacement prior to placing of the concrete. Do not paint or coat the bars with any material before placing them in the concrete.

If placing tie bars along a longitudinal construction joint using the method of inserting bars with a 90 degree bend in the edge of the plastic concrete and after the concrete hardens straightening these bars, use Grade 40 reinforcing steel for such tie bars. Replace any bar broken while being straightened in an approved manner.

350-12.3 Transverse Joints:

350-12.3.1 Transverse Construction Joints: Construct transverse construction joints at the end of all pours and at other locations where the paving operations are stopped for as long as 30 minutes. Do not place construction joints, however, within 10 feet of any other transverse joint or within 10 feet of either end of a section of pavement. If sufficient concrete has not been placed to form a slab at least 10 feet long, remove the excess concrete, back to the last preceding joint. Form the joints by placing a wood or metal bulkhead accurately and securely in place, in a plane perpendicular to the profile and centerline of the pavement. Install dowel bars at the construction joints. Saw or form construction joints, in a manner similar to contraction joints, so that a groove will be formed for holding the joint sealing compound.

350-12.3.2 Transverse Contraction Joints: Construct transverse contraction joints at the interval indicated in the Plans consisting of planes of weakness created by sawing a groove in the surface of the hardened concrete. Place the groove perpendicular to the surface of the pavement. Install load transfer devices in transverse contraction joints.

Ensure that the sawing equipment does not damage the pavement, and saw the transverse contraction joints as soon as the pavement has hardened to the degree that tearing and raveling are not excessive and before uncontrolled shrinkage cracking begins.

Accomplish the joint sawing in two steps. Make the initial cut 1/8 inch wide by a depth at least 1/3 of the pavement thickness and as soon as possible but in no case longer than 12 hours after placing the concrete. Make a second saw cut, to provide the joint dimensions indicated in the Plans, just prior to sealing the load transfer device.

In cases where a strip of pavement is being placed immediately adjacent to a previously constructed strip of pavement, construct transverse contraction joints using extreme care to time sawing so as to prevent uncontrolled cracks.

Repair any uncontrolled cracks at no expense to the Department by removing and replacing the pavement across the full width of all affected lanes or shoulders and to the nearest transverse joint in each direction.

After the final sawing, clean the joint, install the bond breaker, and seal the joint.

350-12.3.3 Transverse Expansion Joints: Form transverse expansion joints using preformed joint filler, and provide them with dowel load transfer, in accordance with the details shown on the Design Standards, or in the Plans.

Form the joints during the placing of the concrete, by securely staking a metal bulkhead accurately in place at the joint location or by other methods which will securely brace and support the joint filler. Where using approved devices to keep the expansion joint filler and dowels securely in place, the Engineer will not require a bulkhead. Protect all transverse expansion joints at the bottom and side edges by a sheet metal strip as specified in 931-2.1 and as shown in the Contract Documents.

Cut the filler to the crown and shape of the slab cross-section and extended it to the subgrade. After installation, ensure that the top is not less than 1 inch, and not more than 1.25 inches, below

the finished surface. Furnish the joint filler in lengths not less than the lane widths being poured, except that the Engineer will not require lengths greater than 12 feet. Where more than one section is allowed and used in a joint, securely lace or clip the sections together.

Place the filler normal to the pavement surface. Stake the assembly into position in such a way as to hold the assembly securely in position throughout construction. Ensure that the assembly is true to the line prescribed, subject to a tolerance of 1/4 inch in the width of the slab. Obtain the Engineer's approval of the assembly and its installation before placing any concrete against it. Obtain the Engineer's approval of the cross-section and length of the stakes.

When laying the pavement in partial width slabs, place transverse joints in the succeeding slab in line with the like joints in the first slab. In the case of widening existing pavement, place transverse joints in line with like joints in the existing pavement or as otherwise shown in the Plans.

350-12.4 Load-Transfer Devices: Provide dowel load-transfer devices in all transverse joints. Firmly hold dowel bars in a position parallel to the surface and the centerline of the slab, by approved steel supports and spacers of a type shown in the Plans. The Engineer may approve the use of dowel bar supports or assemblies other than those specifically detailed in the Plans. Allow the dowels to be free to move in one slab as the concrete contracts and expands. Paint each dowel with one coat of zinc rich primer or red oxide alkyd based primer meeting the requirements of SSPC Paint 25 Type I or Type II. Wait a minimum of 7 days before coating one-half of the dowel with a petroleum based lubricant grease to inhibit bonding to the concrete. Provide a cap for the free end of expansion joint dowels.

Position each dowel such that its final deviation from parallel to the surface of the pavement and parallel to the longitudinal centerline of the pavement does not exceed 1/2 inch. Position each dowel such that its final deviation from being centered on the joint does not exceed 2 inches. Position each dowel such that at no point in its length does it deviate from the surface of the pavement as shown in the Plans in excess of 1 inch. Confirm the position of dowel bars by suitable means acceptable to the Engineer, which may include non-destructive testing methods.

350-12.5 Expansion Joints Around Structures:

350-12.5.1 Expansion Joints at Manholes, Meter Boxes and other Projections: Form expansion joints by placing premolded expansion joint material about all structures and features projecting through, into or against the pavement. Ensure that such joints are 1/2 inch in width.

350-12.5.2 Bridge Approach Expansion Joints: Construct in accordance with Design Standards, Index No. 306.

350-12.6 Cleaning Joints and Cracks:

350-12.6.1 Cleaning Joints in New Pavement:

350-12.6.1.1 Sawed Joints: Immediately after sawing the joints which require sealing, completely remove the resulting slurry from the joint and the immediate area by flushing with a jet of water under pressure and by using other tools as necessary.

After flushing, blow out the joints with compressed air. After the flushed joints have dried, sandblast the joint faces to thoroughly remove all foreign material. Perform sandblasting in two passes, once for each face. Patch all spalled edges with an epoxy compound.

Immediately prior to joint seal installation, clean the joints using compressed air to remove all traces of debris and dust within and on the joint surfaces.

350-12.6.1.2 Non-Sawed Joints: Thoroughly clean joints which require sealing of all foreign material for the full depth of the seal installation.

With the exception of slurry removal due to sawing, meet the cleaning requirements as specified for sawed joints.

350-12.6.2 Cleaning Joints in Existing Pavement: Remove all existing joint- sealing material and foreign material for the full depth of the new joint seal by sawing, wire brushing, sandblasting, or other methods approved by the Engineer.

Remove any existing sealant or parting strip material below the tape or backer rod bond breaker and replace it with additional bond breaker. When conditions require removal and replacement with additional bond breaker below the new joint seal, obtain the Engineer's approval of the type of bond breaker and its installation procedure. Perform cleaning by any method or combination of methods, as detailed in the Plans.

Flush the joint with a pressurized jet of water, and use other tools as necessary, to remove loose remnants and debris.

After flushing, blow out the joints with compressed air. After the flushed joints have dried, sandblast the joint faces to thoroughly remove all foreign material. Perform sandblasting in two passes, once for each face.

Patch all spalled edges with an epoxy compound.

Immediately prior to joint seal installation, clean the joints using compressed air to remove all traces of debris and dust within and on the joint surfaces.

350-12.6.3 Cleaning Random Cracks in Existing Pavement: Do not begin cleaning random cracks in existing pavement until all other concrete pavement repairs have progressed to the point where those operations will not adversely affect the installation of the new seal.

Cut the random cracks to be repaired and sealed into grooved joints to the depth and width detailed in the Plans. Clean the joints as specified in 350-12.6.2.

350-12.7 Sealing Joints and Cracks: Seal joints in new pavement before allowing any traffic or construction equipment on the pavement. Complete sealing within 72 hours (weather permitting) of sawing. If traffic is going to be on the pavement prior to any grinding, then seal the joints with a temporary material acceptable to the Engineer.

When using silicone and non-silicone sealants in the transverse and longitudinal joints, respectively, always use the silicone sealants first to prevent contamination at the intersection of the joint faces. Remove non-silicone sealant 1 foot in each direction from the transverse joints, and replace it with silicone sealant.

Use equipment equipped with nozzles that discharge the sealant at the bottom of the groove. Ensure that the apparatus develops sufficient pressure to extrude the joint sealer from the nozzles satisfactorily and to control the rate of application so as to completely fill the joint to within 1/4 inch of the surface of the pavement without spillage. Use an apparatus so constructed that it maintains the proper temperature of the sealing material within the manufacturer's recommendation.

350-12.7.1 Hot-Poured Type Sealant: When the Plans require hot poured sealant for specific joints, fill the joint thoroughly, without trapping air, ensuring the sealant is recessed below the pavement surface as required, and control the pouring rate to avoid spilling of sealant onto the adjacent pavement surface. If any spilling of sealant occurs, immediately remove and clean the entire surplus amount from the pavement surface. Place poured material when the ambient air temperature is 50°F or greater.

Use an indirect heating or double boiler type heating kettle that uses oil as a heat transfer medium, for hot poured sealer. Use a heating kettle that has a thermostatically controlled heat source, a built-in automatic agitator, and thermometers installed to indicate both the temperature of the melted sealing material and that of the oil bath.

350-12.7.2 Low Modulus Silicone Sealant: Use low modulus silicone sealant of either Type A (non-self-leveling silicone sealant), or Type B and/or Type C (self-leveling silicone sealant). Because Type A will not flow into the proper shape under its own weight, install and tool it so that the sealant is in firm contact with the joint faces and is formed into the appropriate shape as specified. Types B and C will normally flow into the proper shape without tooling. Exercise care to provide the required depth of recess above the sealant surface and below the pavement surface. Install the silicone sealant at temperatures above 40°F.

350-13 Surface Requirements.

Produce, by grinding in accordance with Section 352, a pavement surface that is true to grade and uniform in appearance with a longitudinal line type texture.

350-14 Thickness Determinations.

350-14.1 General: After completing the concrete pavement, including any corrective work to meet ride requirement, determine the thickness by one of following methods. The Engineer will select the locations for testing and make the determination of thickness. Sample locations will be taken at various points on the cross-section so that each test represents an area not exceeding 2,500 yd². Provide traffic control, non-destructive equipment, coring equipment, and operator to obtain the samples.

350-14.1.1 Core Borings: To determine the actual thickness, drill cores from the pavement and measure thickness in accordance with ASTM C174. Replace the portions of the pavement removed by the borings at no expense to the Department.

350-14.1.2 Non-destructive Testing: For a determination using the impact-echo method, measure the thickness of the pavement in accordance with ASTM C1383. The initial thickness measurement will be validated by having a core boring taken at that location in compliance with 350-14.1.1. If the results from the impact-echo test vary by plus or minus 1.15 inches from the core boring, then the non-destructive test method cannot be used on the pavement. In such case, the core boring will be used for acceptance of that LOT of concrete. The Engineer has the option to verify the accuracy of the results at any time.

350-14.2 Method of Calculating Average Thickness: The Department will determine the average thickness of the pavement by using the following method of calculation:

- (a) The Department will not take into account in the calculation, any areas of pavement which are left in place, but for which no payment will be made.
- (b) When the thickness of the pavement is more than 1/2 inch greater than the specified thickness, the Department will consider it in the calculation as the specified thickness plus 1/2 inch.
- (c) The Department will calculate the average thickness for the entire job as a unit.

350-15 Deficient Thickness.

350-15.1 General: The Department will not pay for any pavement which is more than 1/2 inch less than the specified thickness. Any deficient pavement will be just cause for that portion of the concrete pavement addressed in the QCP to be suspended until the corrections are to the satisfaction of the Engineer. When the pavement contains no longitudinal construction joint, the Department will not pay for the area of such pavement that is the product of the full width of the strip placed as a unit times the sum of the distances each way from the short core or cores to the cores on each side which show measurements within the tolerance limits. When the pavement contains longitudinal construction joints, for the width, the Department will use the width between longitudinal construction joint and the edge of pavement.

350-15.2 Deficient Pavement Requiring Removal: The Engineer will evaluate areas of pavement found deficient in thickness by more than 1/2 inch and if, in his judgment, the deficiency is enough to seriously impair the anticipated service life of the pavement, remove such areas and replace them with concrete of the thickness shown in the Plans. The Department will not pay for the area of pavement removed or for the materials or labor involved in its removal. When removing a section of pavement, remove the full length between transverse joints.

350-15.3 Deficient Pavement Left in Place: If the Engineer determines that the deficiency will not seriously impair the anticipated service life of the pavement, the pavement may be left in place, at no compensation.

350-15.4 Additional Borings: If the number of cores taken is not sufficient to indicate the thickness of the pavement, additional boring locations may be requested, with prior approval from the Engineer at no additional cost to the Department.

350-16 Opening Pavement to Traffic.

Construct an earth berm along each edge of the pavement within 36 hours of finishing any newly placed concrete pavement. Build the berm to the full height of the pavement and at least 18 inches wide, and sufficiently compacted to prevent underwash of the pavement.

Maintain the berm until the final shoulders are complete.

Except as provided below, keep the pavement closed to traffic for a minimum period of 14 calendar days after placement of the concrete. The Engineer may permit opening of a section of pavement to traffic at an earlier time provided that representative test cylinders, made in accordance with ASTM C31 and tested in accordance with ASTM C39, indicate a compressive strength of at least 2200 psi. Cure these test cylinders in a manner identical to the corresponding section of pavement.

Protect the pavement from all traffic, including construction operations, until the specified period of time has elapsed. Protect the pavement from ambient temperatures below 50°F for the calendar days or until the required compressive strength has been attained.

350-17 Method of Measurement.

350-17.1 Concrete Pavement: The quantities to be paid for will be the plan quantity, in square yards, of plain cement concrete pavement and of reinforced cement concrete pavement, omitting any areas not allowed for payment under the provisions of 350-15.3 and adjusted for average thickness as provided herein.

For purposes of payment, the average thickness of pavement will determine the final pay quantities for this pavement as follows:

The area of pavement represented by the difference between the calculated average thickness and the specified thickness will be converted into equivalent square yards of specified thickness pavement, and the quantity thereby obtained will be added to, or deducted from, the quantity of pavement to be paid for, subject to the limitation that the maximum average of over-thickness permitted in the adjustment of the quantity of pavement to be paid for will be 1/4 inch.

Where the Plans call for cement concrete pavement that is to be covered with asphalt concrete surface course, payment will be made for the total thickness of the combination as plain cement concrete pavement.

In such cases, price and payment will also include all costs of the asphalt concrete surface course constructed in accordance with Section 334. Reinforcing steel, placed and accepted, will be measured and paid for as provided in Section 415.

350-17.2 Joints and Cracks: Include the cost for cleaning and sealing joints in the cost of the newly constructed pavement for: (1) transverse and longitudinal joint construction for new pavement; and (2) abutting joints between existing pavement and new pavement.

For replacing joint seals and sealing random cracks in existing portland cement concrete pavement, the quantity to be paid for will be as specified below:

- (a) The length of pavement joint satisfactorily cleaned and sealed in existing portland cement concrete pavement, as determined by field measurement along the joints, will be paid for at the Contract unit price per foot for cleaning and resealing joints.
- (b) The length of random cracks in existing portland cement concrete pavement that have been satisfactorily cut, cleaned, and sealed, as determined by field measurement along the joints, will be paid for at the Contract unit price per foot for cleaning and sealing random cracks.

350-17.3 Bridge Approach Expansion Joint: The quantity to be paid for will be plan quantity, in feet of bridge approach expansion joint installed in accordance with Design Standards, Index No. 306, calculated across the pavement at right angles to the centerline of the roadway pavement, completed and accepted.

350-18 Basis of Payment.

Prices and payments will be full compensation for all work specified in this Section, including any preparation of the subgrade not included in the work to be paid for under another Contract item; all transverse and longitudinal joint construction, including tie-bars and dowel bars; the furnishing of test specimens; repair of core holes; and all incidentals necessary to complete the work.

Payment will be made under:

No separate payment shall be made for Cement Concrete Pavement. Payment for Cement Concrete Pavement shall be incidental to the unit prices included in Section 346 of which it is a part.

**SECTION 425
INLETS, MANHOLES, AND
JUNCTION BOXES**

425-1 Description.

Construct inlets, manholes, and junction boxes from reinforced concrete as shown in the Design Standards and the plans. Brick masonry may be used if the structure is circular and constructed in place. Furnish and install the necessary metal frames and gratings. Construct yard drains from concrete meeting the requirements of Section 347. Adjust structures shown in the plans to be adjusted or requiring adjustment for the satisfactory completion of the work.

425-2 Composition and Proportioning.

425-2.1 Concrete: For inlets, manholes, and junction boxes, use Class II or IV concrete, as designated in the plans and Design Standards and as specified in Section 346. For yard drains use concrete as specified in Section 347.

425-2.2 Mortar: For brick masonry, make the mortar by mixing one part portland cement to three parts sand. Miami Oolitic rock screenings may be substituted for the sand, provided the screenings meet the requirements of 902-5.2.3 except for gradation requirements. Use materials passing the No. 8 sieve that are uniformly graded from coarse to fine.

Masonry cement may be used in lieu of the above-specified mortar provided it is delivered in packages properly identified by brand name of manufacturer, net weight of package, and whether it is Type 1 or Type 2, and further provided that it has not been in storage for a period greater than six months.

425-3 Materials.

425-3.1 General: Meet the following requirements:

Sand (for mortar).....	902-3.2
Portland Cement.....	Section 921
Water.....	Section 923
Reinforcing Steel	931-1.1 and 415-3
Brick and Concrete Masonry Units	Section 949
Castings for Frames and Gratings.....	962

425-3.2 Gratings: Use gratings and frames fabricated from structural steel or cast iron as designated in the appropriate Design Standard. When "Alt. G" grates are specified in the plans, provide structural steel grates that are galvanized in accordance with the requirements of ASTM A-123.

425-4 Forms.

Design and construct wood or metal forms so that they may be removed without damaging the concrete. Build forms true to line and grade and brace them in a substantial and unyielding manner. Obtain the Engineer's approval before filling them with concrete.

425-5 Precast Inlets, Manholes, and Junction Boxes.

Precast inlets, manholes and junction boxes, designed and fabricated in accordance with the plans, the Design Standards and Section 449, may be substituted for cast-in-place units.

425-6 Construction Methods.

425-6.1 Excavation: Excavate as specified in Section 125.

Where unsuitable material for foundations is encountered, excavate the unsuitable material and backfill with suitable material prior to constructing or setting inlets, manholes and junction boxes.

As an option to the above and with the Engineer's approval, the Contractor may carry the walls down to a depth required for a satisfactory foundation, backfill to 8 inches below the flowline with clean sand and cast a non-reinforced 8 inch floor.

425-6.2 Placing and Curing Concrete: Place the concrete in the forms, to the depth shown in the plans, and thoroughly vibrate it. After the concrete has hardened sufficiently, cover it with suitable material and keep it moist for a period of three days. Finish the traffic surface in accordance with 522-7.2, or with a simulated broom finish approved by the Engineer.

425-6.3 Setting Manhole Castings: After curing the concrete as specified above, set the frame of the casting in a full mortar bed composed of one part portland cement to two parts of fine aggregate.

425-6.4 Reinforcing Steel: Follow the construction methods for the steel reinforcement as specified in Section 415.

425-6.5 Laying Brick: Saturate all brick with water before laying. Bond the brick thoroughly into the mortar using the shovejoint method to lay the brick. Arrange headers and stretchers so as to bond the mass thoroughly. Finish the joints properly as the work progresses and ensure that they are not less than 1/4 inch or more than 3/4 inch in thickness. Do not use spalls or bats except for shaping around irregular openings or when unavoidable at corners.

425-6.6 Backfilling: Backfill as specified in Section 125, meeting the specific requirements for backfilling and compaction around inlets, manholes, and junction boxes detailed in 125-8.1 and 125-8.2. However, for outfall lines beyond the sidewalk or future sidewalk area, where no vehicular traffic will pass over the pipe, inlets, manholes, and junction boxes, compact backfill as required in 125-9.2.2.

425-6.7 Adjusting Existing Structures: Cut down or extend existing manholes, catch basins, inlets, valve boxes, etc., within the limits of the proposed work, to meet the finished grade of the proposed pavement, or if outside of the proposed pavement area, to the finished grade designated on the plans for such structures. Use materials and construction methods which meet the requirements specified above to cut down or extend the existing structures.

The Contractor may extend manholes needing to be raised using adjustable extension rings of the type which do not require the removal of the existing manhole frame. Use an extension device that provides positive locking action and permits adjustment in height as well as diameter and meets the approval of the Engineer.

425-7 Method of Measurement.

The quantities to be paid for will be (1) the number of inlets, manholes, junction boxes, and yard drains, completed and accepted; and (2) the number of structures of these types (including also valve boxes) satisfactorily adjusted.

425-8 Basis of Payment.

425-8.1 New Structures: Price and payment will be full compensation for furnishing all materials and completing all work described herein or shown in the plans, including all clearing and grubbing outside the limits of clearing and grubbing as shown in the plans, all excavation except the volume included in the measurement designated to be paid for under the items for the grading work on the project, all backfilling around the structures, the disposal of surplus material, and the furnishing and placing of all gratings, frames, covers, and any other necessary fittings.

425-8.2 Adjusted Structures: When an item of payment for adjusting manholes, valve boxes, or inlets is provided in the proposal, price and payment will be full compensation for the number of such structures designated to be paid for under such separate items, and which are satisfactorily adjusted, at the Contract unit prices each for Adjusting Inlets, Adjusting Manholes, and Adjusting Valve Boxes.

For any of such types of these structures required to be adjusted but for which no separate item of payment is shown in the proposal for the specific type, payment will be made under the item of Adjusting Miscellaneous Structures.

425-8.3 Payment Items: Payment will be made under:

<i>Item No. 425- 1-</i>	<i>FDOT Type "F" DBI – per Each (EA)</i>
<i>Item No. 425- 2-</i>	<i>ADS, Yard Drain – per Each (EA)</i>

**SECTION 430
PIPE CULVERTS**

430-1 Description.

Furnish and install drainage pipe and end sections at the locations called for in the plans. Furnish and construct joints and connections to existing pipes, catch basins, inlets, manholes, walls, etc., as may be required to complete the work.

Construct structural plate pipe culverts or underdrains in accordance with Sections 435 and 440.

Obtain pipe culverts from a Producer currently on the Department's list of Producers with Accepted Quality Control Programs. Producers seeking inclusion on the list shall meet the requirements of 105-3.

When the producer's Quality Control Program is suspended, accept responsibility of either obtaining drainage products from another producer with an accepted Quality Control Program or await re-approval of the producer's Quality Control Program. The Engineer will not allow changes in Contract Time or completion dates as a result of the producer's Quality Control Program suspension. Accept responsibility for all delay costs or other costs associated with the producer's Quality Control Program suspension.

430-2 Materials.

430-2.1 Pipe: Meet the following requirements:

Concrete Pipe	Section 449
Round Rubber Gaskets	Section 942
Corrugated Steel Pipe and Pipe Arch	Section 943
Corrugated Aluminum Pipe and Pipe Arch	Section 945
Corrugated Polyethylene Pipe	Section 948
Polyvinyl Chloride (PVC) Pipe	Section 948

430-2.2 Joint Materials: Use joint materials specified in 430-7 through 430-10 according to type of pipe and conditions of usage.

430-2.3 Mortar: Use mortar composed of one part portland cement and two parts of clean, sharp sand, to which mixture the Contractor may add hydrated lime in an amount not to exceed 15% of the cement content. Use mortar within 30 minutes after its preparation.

430-3 Type of Pipe to Be Used.

430-3.1 General: When the plans designate a type (or types) of pipe, use only the type (or choose from the types) designated. As an exception, when the plans designate reinforced concrete pipe as Class S, Class I, Class II, Class III and Class IV, the Contractor may use non- reinforced concrete pipe up to and including 36 inch in diameter.

430-3.2 Side Drain: If the plans do not designate a type (or types) of pipe, the Contractor may use either a minimum Class I concrete pipe, corrugated steel pipe, corrugated aluminum pipe, corrugated polyethylene pipe or PVC pipe. If one of the metal types is chosen, use the minimum gage specified in Section 943 for steel pipe or Section 945 for aluminum pipe.

Non-reinforced concrete pipe may also be substituted for concrete pipe in side drains, subject to the provisions of 430-3.1.

430-4 Laying Pipe.

430-4.1 General: Lay all pipe, true to the lines and grades given, with hubs upgrate and tongue end fully entered into the hub. When pipe with quadrant reinforcement or circular pipe with elliptical reinforcement is used, install the pipe in a position such that the manufacturer's marks designating "top" and "bottom" of the pipe are not more than five degrees from the vertical plane through the longitudinal axis of the pipe. Do not allow departure from and return to plan alignment and grade to exceed 1/16 inch per foot of nominal pipe length, with a total of not more than 1 inch departure from theoretical line and grade. Take up and relay any pipe that is not in true alignment or which shows any settlement after laying at no additional expense to the Department.

Do not use concrete pipe with lift holes except round pipe which has a inside diameter in excess of 54 inches or any elliptical pipe.

Repair lift holes, if present, by use of a hand-placed, stiff, non-shrink, 1-to-1 mortar of cement and fine sand, after first washing out the hole with water. Completely fill the void created by the lift hole with mortar. Cover the repaired area with a 24 by 24 inches piece of filter fabric secured to the pipe. Use a Type D-3 filter fabric meeting the requirements shown on Design Standards, Index 199.

Secure the filter fabric to the pipe using a method that holds the fabric in place until the backfill is placed and compacted. Use a grout mixtures, mastics, or strapping devices to secure the fabric to the pipe.

When installing pipes in structures, construct inlet and outlet pipes of the same size and kind as the connecting pipe shown in the plans. Extend the pipes through the walls for a distance beyond the outside surface sufficient for the intended connections, and construct the concrete around them neatly to prevent leakage along their outer surface as shown on the Design Standards, Index 201. Keep the inlet and outlet pipes flush with the inside of the wall. Resilient connectors as specified in 942-3 may be used in lieu of a masonry seal.

Furnish and install a filter fabric jacket around all pipe joints and the joint between the pipe and the structure in accordance with Design Standards, Index Nos. 201 and 280. Use fabric meeting the physical requirements of Type D-3 specified on the Design Standards, Index 199. The fabric shall extend a minimum of 12 inches beyond each side of the joint or both edges of the coupling band, if a coupling band is used. The fabric shall have a minimum width of 24 inches, and a length sufficient to provide a minimum overlap of 24 inches. Secure the filter fabric jacket against the outside of the pipe by metal or plastic strapping or by other methods approved by the Engineer.

Meet the following minimum joint standards:

Pipe Application	Minimum Standard
Storm and Cross Drains	Water-tight
Gutter Drain	Water-tight
Side Drains	Soil-tight

When rubber gaskets are to be installed in the pipe joint, the gasket shall be the sole element relied on to maintain a tight joint. Soil tight joints must be watertight to 2 psi. Water-tight joints must be water-tight to 5 psi unless a higher pressure rating is required in the plans.

430-4.2 Trench Excavation: Excavate the trench for storm and cross drains, and side drains as specified in Section 125.

430-4.3 Foundation: Provide a suitable foundation, where the foundation material is of inadequate supporting value, as determined by the Engineer. Remove the unsuitable material and replace it with suitable material, as specified in 125-8. Where in the Engineer's opinion, the removal and replacement of unsuitable material is not practicable, he may direct alternates in the design of the pipe line, as required to provide adequate support. Minor changes in the grade or alignment will not be considered as an adequate basis for extra compensation.

Do not lay pipe on blocks or timbers, or on other unyielding material, except where the use of such devices is called for in the plans.

430-4.4 Backfilling: Backfill around the pipe as specified in 125-8 unless specific backfilling procedures are described in the Contract Documents.

430-4.5 Plugging Pipe: When existing pipe culverts are to be permanently placed out of service, fill them with flowable fill that is non-excavatable, contains a minimum 350 lbs/cy of cementitious material and meets the requirements of Section 121 and/or plug them with masonry plugs as shown in the plans. Install masonry plugs that are a minimum of 8 inches in thickness, in accordance with Design Standards Index 280.

When proposed or existing pipe culverts are to be temporarily placed out of service, plug them with prefabricated plugs as shown in the plans. Install prefabricated plugs in accordance with the manufacturer's recommendations. Do not fill, or construct masonry plugs in, any pipe culverts intended for current or future service.

430-4.6 End Treatment: Place an end treatment at each storm and cross drain, and side drain as shown in the plans. Refer to the Design Standards for types of end treatment details.

As an exception to the above, when concrete mitered end sections are permitted, the Contractor may use reinforced concrete U-endwalls, if shop drawings are submitted to the Engineer for approval prior to use.

Provide end treatments for corrugated polyethylene pipe and PVC pipe as specified in Section 948, or as detailed in the plans.

430-4.7 Metal Pipe Protection: Apply a bituminous coating to the surface area of the pipe within and 12 inches beyond the concrete or mortar seal prior to sealing, to protect corrugated steel or aluminum pipe embedded in a concrete structure, such as an inlet, manhole, junction box, endwall, or concrete jacket.

Ensure that the surface preparation, application methods (dry film thickness and conditions during application), and equipment used are in accordance with the coating manufacturers' published specifications.

Obtain the Engineer's approval of the coating products used.

430-4.8 Final Pipe Inspection: Based on contract pavement type, upon completion of placement of concrete pavement or the placement of structural asphalt, but prior to placement of asphalt friction course, dewater installed pipe and provide the Engineer with a video recording schedule allowing for pipe videoing and reports to be completed and submitted to the Department and reviewed prior to continuation of pavement.

For pipe 48 inches or less in diameter, provide the Engineer a video DVD and report using low barrel distortion video equipment with laser profile technology, non-contact video micrometer and associated software that provides:

1. Actual recorded length and width measurements of all cracks within the pipe.
2. Actual recorded separation measurement of all pipe joints.
3. Pipe ovality report.
4. Deflection measurements and graphical diameter analysis report in terms of x and y axis.
5. Flat analysis report.
6. Representative diameter of pipe.
7. Pipe deformation measurements, leaks, debris, or other damage or defects.
8. Deviation in pipe line and grade, joint gaps, and joint misalignment.

Laser profiling and measurement technology must be certified by the company performing the work to be in compliance with the calibration criteria posted at: www.dot.state.fl.us/construction/contractorissues/laser.htm . Reports may be submitted in electronic media if approved by the Engineer.

For video recorded, laser profiled pipe that indicates deflection that appears to be in excess of that allowed by Specification, the Engineer may require further testing of the pipe. If directed by the Engineer, test pipe using a mandrel. The mandrel shall be pulled by hand and be approved by the Engineer prior to use. If use of a mandrel is selected as the means of further testing, the mandrel's diameter, length, and other requirements shall conform to 430-4.8.2. Remove, replace, and retest pipe failing to meet the specific deflection requirements for the type of pipe installed, at no cost to the Department. Should the deflection test prove that the pipe met specifications, the Department will bear the cost of the deflection testing.

The Engineer may waive this requirement for side drains and cross drains which are short enough to inspect from each end of the pipe.

430-4.8.1 Video Report: Provide a high quality DVD in a MPEG2 format video with a standard resolution of 720 x 480. Use a camera with lighting suitable to allow a clear picture of the entire periphery of the pipe. Center the camera in the pipe both vertically and horizontally and be able to pan and tilt to a 90 degree angle with the axis of the pipe and rotating 360 degrees. Use equipment to move the camera through the pipe that will not obstruct the camera's view or interfere with proper documentation of the pipe's condition.

The video image shall be clear, focused, and relatively free from roll, static, or other image distortion qualities that would prevent the reviewer from evaluating the condition of the pipe. The video will include identification before each section of pipe filmed. The identification will include the project number, the structure number corresponding to the structure number on the set of plans for the project, size of pipe, the date and time, and indicate which pipe is being filmed if multiple pipes are connected to the structure. Notes should be taken during the video recording process. Provide the Engineer with copies of these notes along with the video.

Move the camera through the pipe at a speed not greater than 30 feet per minute. Mark the video with the distance down the pipe. The distance shall have an accuracy of one foot per 100 feet. Film the entire circumference at each joint. Stop the camera and pan when necessary to document defects.

430-4.8.2 Mandrels: Use mandrels which are rigid, nonadjustable, odd-numbered legged (minimum 9 legs) having a length not less than its nominal diameter. The diameter at any point shall not be less than the allowed percent deflection of the certified actual mean diameter of the pipe being tested. The mandrel shall be fabricated of metal, fitted with pulling rings at each end, stamped or engraved on some segment other than a runner with the nominal pipe size and mandrel outside diameter.

430-5 Removing Existing Pipe.

If the plans indicate that existing pipe is to remain the property of the Department, collect and stack along the right-of-way all existing pipe or pipe arch so indicated in the plans to be removed, or that does not conform to the lines and grades of the proposed work and that is not to be re-laid, as directed by the Engineer. Take care to prevent damage to salvageable pipe during removal and stacking operations.

430-6 Placing Pipe Under Railroad.

430-6.1 General: Construct pipe culverts under railroad tracks in accordance with the requirements of the railroad company.

Perform all the shoring under the tracks, and sheeting and bracing of the trench, required by the railroad company or deemed necessary by the Engineer in order to ensure safe and uninterrupted movement of the railroad equipment, at no expense to the Department.

430-6.2 Requirements of the Railroad Company: Install pipe using methods required by the railroad company and shown in the Contract Documents.

When the general method of installation required by the railroad company is indicated in the plans, do not alter such method, or any other specific details of the installation which might be indicated in the plans, without receiving approval or direction from the railroad, followed by written approval from the Engineer.

430-6.3 Notification to Railroad Company: Notify the railroad company and the Engineer at least ten days prior to the date on which pipe is to be placed under the railroad tracks.

430-6.4 Placing Pipe by Jacking: Obtain the Engineer's and the railroad company's approval of the details of the jacking method to be used, when placing pipe through the railroad embankment, before the work is started.

430-6.5 Use of Tunnel Liner: When the railroad company requires that a tunnel liner be used for placing

the pipe in lieu of the jacking method, the Department will pay for the tunnel liner material separately in cases where the Contract Documents do not require the use of a tunnel liner. For these cases the Department will reimburse the Contractor for the actual cost of the liner, delivered at the site. The Department will base such cost on a liner having the minimum gage acceptable to the railroad.

430-7 Specific Requirements for Concrete Pipe.

430-7.1 Sealing Joints: Seal the pipe joints with round rubber or profile gaskets meeting the requirements of Section 449. Ensure that the gasket and the surface of the pipe joint, including the gasket recess, are clean and free from grit, dirt and other foreign matter, at the time the joints are made. In order to facilitate closure of the joint, application of a vegetable soap lubricant immediately before closing of the joint will be permitted. Prelubricated gaskets may be used in lieu of a vegetable soap lubricant when the lubricating material is certified to be inert with respect to the rubber material.

430-7.2 Laying Requirements for Concrete Pipe with Rubber Gasket Joints: Do not allow the gap between sections of pipe to exceed 5/8 inch for pipe diameters of 12 inches through 18 inches, 7/8 inch for pipe diameters of 24 through 66 inches, and 1 inch for pipe diameters 72 inches and larger. Where minor imperfections in the manufacture of the pipe create an apparent gap in excess of the tabulated gap, the Engineer will accept the joint provided that the imperfection does not exceed 1/3 the circumference of the pipe, and the rubber gasket is 1/4 inch or more past the pipe joint entrance taper. Where concrete pipes are outside of these tolerances, replace them at no expense to the Department. Do not apply mortar, joint compound, or other filler to the gap which would restrict the flexibility of the joint.

430-7.3 Field Joints for Elliptical Concrete Pipe: Use either a preformed plastic gasket material or an approved rubber gasket to make a field joint.

430-7.3.1 Plastic Gasket: Meet the following requirements when field joints are made from preformed plastic gasket material:

430-7.3.1.1 General: Install field joints in accordance with the manufacturer's instructions and the following:

430-7.3.1.2 Material: Meet the requirements of 942-2.

430-7.3.1.3 Joint Design: Ensure that the pipe manufacturer furnishes the Engineer with details regarding configuration of the joint and the amount of gasket material required to affect a satisfactory seal. Do not brush or wipe joint surfaces which are to be in contact with the gasket material with a cement slurry. Fill minor voids with cement slurry.

430-7.3.1.4 Primer: Apply a primer of the type recommended by the manufacturer of the gasket material to all joint surfaces which are to be in contact with the gasket material, prior to application of the gasket material. Thoroughly clean and dry the surface to be primed.

430-7.3.1.5 Application of Gasket: Apply gasket material to form a continuous gasket around the entire circumference of the leading edge of the tongue and the groove joint, in accordance with the detail shown on the Design Standards, Index No. 280. Do not remove the paper wrapper on the exterior surface of the gasket material until immediately prior to joining of sections. Apply plastic gasket material only to surfaces which are dry. When the atmospheric temperature is below 60°F, either store plastic

joint seal gaskets in an area above 70°F, or artificially warm the gaskets to 70°F in a manner satisfactory to the Engineer.

430-7.3.1.6 Installation of Pipe: Remove and reposition or replace any displaced or contaminated gasket as directed by the Engineer. Install the pipe in a dry trench. Carefully shape the bottom of the trench to minimize the need for realignment of sections of pipe after they are placed in the trench. Hold to a minimum any realignment of a joint after the gaskets come into contact. Prior to joining the pipes, fill the entire joint with gasket material and ensure that when the pipes are joined there is evidence of squeeze-out of gasket material for the entire internal and external circumference of the joint. Trim excess material on the interior of the pipe to provide a smooth interior surface. If a joint is defective, remove the leading section of pipe and reseal the joint.

430-7.3.2 Rubber Gasket: Meet the following requirements when field joints are made with profile rubber gaskets:

430-7.3.2.1 General: Install field joints in accordance with the manufacturer's instructions and the following:

430-7.3.2.2 Material: Meet the requirements of 942-4.

430-7.3.2.3 Joint Design: Ensure that the pipe manufacturer furnishes the Engineer with details regarding configuration of the joint and gasket required to effect a satisfactory seal. Do not apply mortar, joint compound, or other filler which would restrict the flexibility of the gasket joint.

430-7.4 Requirements for Concrete Radius Pipe:

430-7.4.1 Design: Construct concrete radius pipe in segments not longer than 4 feet (along the pipe centerline), except where another length is called for in the Contract Documents. Join each segment using round rubber gaskets. Ensure that the pipe manufacturer submits details of the proposed joint, segment length and shape for approval by the Engineer, prior to manufacture.

430-7.4.2 Pre-Assembly: Ensure that the manufacturer pre-assembles the entire radius section in his yard, in the presence of the Engineer, to ensure a proper fit for all parts. At the option of the manufacturer, the Contractor may assemble the pipe without gaskets. Consecutively number the joints on both the interior and exterior surfaces of each joint, and make match marks showing proper position of joints. Install the pipe at the project site in the same order as pre-assembly.

430-8 Specific Requirements for Corrugated Metal Pipe.

430-8.1 Field Joints:

430-8.1.1 General: Make a field joint with locking bands, as specified in Article 9 of AASHTO M 36 and AASHTO M 196M for aluminum pipe. For aluminum pipe, fabricate bands from the same alloy as the culvert sheeting.

When existing pipe to be extended is helically fabricated, make a field joint between the existing pipe and the new pipe using one of the following methods:

- (1) Cut the new pipe to remove one of the re-rolled annular end sections required in Sections 943 or 945, or fabricate the pipe so that the re-rolled annular section is fabricated only on one end. Use either a spiral (helical) band with a gasket or a flat band with gaskets as required by 430-8.1.2 (2) to join the pipe sections.
- (2) The Contractor may construct a concrete jacket as shown on the Design Standards, Index No. 280, provided that the minimum cover required by the Design Standards, Index No. 205 can be obtained.

430-8.1.2 Side Drain, Storm and Cross Drain, and Gutter Drains: Where corrugated metal pipe is used as side drain, storm and cross drain, or gutter drain, use a rubber or neoprene gasket of a design shown to provide a joint as specified in 430-4.

Use a gasket of one of the following dimensions:

- (1) For annular joints with 1/2 inch depth corrugation: either a single gasket a minimum of 7 inches by 3/8 inch or two gaskets a minimum of 3 1/2 inches by 3/8 inch; and for annular joints with 1 inch depth corrugations: either a single gasket a minimum of 7 inches by 7/8 inch or two gaskets a minimum of 3 1/2 inches by 7/8 inch.
- (2) For helical joints with 1/2 inch depth corrugation: either a single gasket a minimum of 5 inches by 1 inch or two gaskets a minimum of 3 1/2 inches by 1 inch; and for helical joints with 1 inch depth corrugations: either a single gasket a minimum of 5 inches by 1 1/2 inches or two gaskets a minimum of 3 1/2 inches by 1 1/2 inches.
- (3) Such other gasket designs as may be approved by the Engineer. If, in lieu of a single gasket spanning the joint, two gaskets are used, place these individual gaskets approximately 2 inches from each pipe end at the joint. When two gaskets are used, seal the overlapping area on the coupling band between the gaskets consistent with the joint performance specified. The Contractor may tuck a strip of preformed gasket material over the bottom lip of the band for this purpose. Use coupling bands that provide a minimum circumferential overlap of 3 inches. As the end connections on the coupling band are tightened, ensure that there is no local bending of the band or the connection. Use precurved coupling bands on pipe diameters of 24 inches or less.

Use flat gaskets meeting the requirements of ASTM D-1056, designation 2C2 or 2B3. In placing flat gaskets on pipe prior to placing the coupling band, do not stretch the gasket more than 15% of its original circumference. Use circular gaskets meeting the requirements of ASTM C-361. Do not stretch the circular gasket more than 20% of its original circumference in placing the gasket on pipe. Use preformed plastic gasket material meeting the composition requirements of 942-2.2.

Apply an approved vegetable soap lubricant, as specified for concrete pipe in 430-7.1.1.

430-8.1.3 Alternate Joint: In lieu of the above-specified combination of locking bands and flat gaskets, the Contractor may make field joints for these pipe installations by the following combinations:

- (a) Use the metal bands as specified in Article 9 of AASHTO M 36M that are at least 10 1/2 inches wide and consist of a flat central section with a corrugated section near

each end, designed to match the annular corrugation in the pipe with which they are to be used. Connect the bands in a manner approved by the Engineer, with a suitable fastening device such as the use of two galvanized 1/2 inch diameter bolts through a galvanized bar and galvanized strap, suitably welded to the band. Use a strap that is the same gage as the band.

Where helically corrugated pipe is to be jointed by this alternate combination, ensure that at least the last two corrugations of each pipe section are annular, and designed such that the band will engage each pipe end with the next-to-outside annular corrugation.

- (b) For these bands, use a rubber gasket with a circular cross-section of the “O-ring” type conforming to ASTM C-361. Use gaskets having the following cross-sectional diameter for the given size of pipe:

Non-SI Units	
Pipe Size	Gasket Diameter
12 inches through 36 inches (with 1/2 inch depth corrugations)	13/16 inch
42 inches through 96 inches (with 1/2 inch depth corrugations)	7/8 inch
36 inches through 120 inches (with 1 inch depth corrugations)	1 3/8 inches

Use preformed gasket material to seal the overlapping area on the coupling band between gaskets.

- (c) Use channel band couplers in helical pipe with ends which have been reformed and flanged specifically to receive these bands. Use channel band couplers that are of a two piece design, are fabricated from galvanized steel stock conforming to AASHTO M 36, have 2 by 2 by 3/16 inch angles fastened to the band ends to allow for proper tightening, and meet the following:

Non SI Units	
Band Thickness	Pipe Wall Thickness
0.079 inch	0.109 inch or lighter
0.109 inch	0.138 inch or heavier
3/4 inch wide	0.109 inch or lighter
1 inch wide	0.138 inch or heavier

Furnish two 1/2 inch diameter connection bolts with each band, that conform to ASTM A-307, Grade A and are electroplated in accordance with ASTM B-633.

Use a gasket with the joint that is a hydrocarbon blend of butyl rubber meeting the chemical composition and physical properties of 942-2.2. Use a 3/8 by 3/4 inch gasket for pipe fabricated from 0.109 inch or lighter material and a 3/8 by 1 inch gasket for pipe fabricated from 0.138 inch and heavier material.

The Contractor may use a flange band coupler without the gasket for all applications other than side drain, storm and cross drain, and gutter drain.

Do not use the flange band coupler to join dissimilar types of pipe.

The Contractor may join reformed flanged helical pipe to existing annular or reformed pipe having annular ends. On non-gasketed installations, use either an annular band or an alternate joint described in 430-8.1.3. On gasketed installations, use an annular band, minimum of five corrugations in width, in conjunction with two O-ring gaskets as specified in 430-8.1.3. Use mastic material to seal the area of band overlap.

The minimum joint performance standards specified in 430-4.1 apply.

430-8.2 Laying and Shape Requirements for Corrugated Metal Pipe: Install pipe using either a trench or open ditch procedure.

Check pipe shape regularly during backfilling to verify acceptability of the construction method used. Pipe deflected 5% or more of the certified actual mean diameter of the pipe at final inspection shall be replaced at no cost to the Department. Deflection measurements are taken at the point of smallest diameter on the corrugations.

430-9. Specific Requirements for Corrugated Polyethylene Pipe and Polyvinyl Chloride (PVC) Pipe.

430-9.1 Field Joints: Use gasketed joints to seal side drain, and storm and cross drain. Use gaskets meeting the requirements of Section 449. Ensure that the pipe manufacturer provides a joint design approved by the Engineer before use.

430-9.2 Installation Requirements Including Trenching, Foundation and Backfilling Operations: Check structure shape regularly during backfilling to verify acceptability of the construction method used.

Pipe deflected 5% or more of the certified actual mean diameter of the pipe at final inspection shall be replaced at no cost to the Department.

430-10 Desilting Pipe or Concrete Box Culvert.

Desilt pipe culvert and concrete box culvert as designated in the plans.

430-11 Method of Measurement.

430-11.1 New Pipe: The quantities of storm and cross drain pipe, storm drain trench, side drain pipe and gutter drain pipe to be paid for will be plan quantity, in place and accepted. The plan quantity will be determined from the inside wall of the structure as shown on the plans, along the centerline of the pipe.

430-11.2 Mitered End Section: The quantity to be paid for will be the number completed and accepted.

430-12 Basis of Payment.

430-12.1 General: Prices and payments will be full compensation for all work specified in this Section, including all excavation except the volume included in the items for the grading work on the project, and except for other items specified for separate payment in Section 125; all backfilling material and compaction; disposal of surplus material; and all clearing and grubbing outside of the required limits of clearing and grubbing as shown in the plans.

430-12.2 Removing Existing Pipe: When existing pipe is removed and replaced with new pipe approximately at the same location, the cost of excavating and removing the old pipe and of its disposal will be included in the Contract unit price for clearing and grubbing.

430-12.3 Site Restoration: The cost of restoring the site, as specified in 125-11, that is disturbed, solely for the purpose of constructing pipe culvert, will be included in the Contract unit price for the pipe culvert, unless designated specifically to be paid for under other items.

430-12.4 Plugging Pipes: The cost of temporarily plugging a pipe culvert, either proposed or existing, will be incidental to the contract unit price for new pipe culvert.

The cost of filling and/or plugging an existing pipe culvert that is to be permanently placed out of service will be paid for at the contract unit price for filling and plugging pipe, per cubic yard. Price and payment will be full compensation for flowable fill, masonry, concrete, mortar, and all labor and materials necessary to complete the work.

When the project includes no quantities for new pipe culverts, and temporary plugs are required for existing pipe culverts, the cost will be considered as extra work, in accordance with 4-3.5.

430-12.5 Desilting Pipe: Desilting Pipe will be paid for at the contract unit price per foot for each pipe desilted. Price and payment will be full compensation for furnishing all equipment, tools and labor, disposal of silt and debris, and all incidentals necessary for satisfactorily performing the work.

430-12.6 Desilting Concrete Box Culverts: Price and payment will be full compensation for all work required.

430-12.7 Flared End Sections: Price and payment will be full compensation for all work and materials required.

430-12.8 Mitered End Sections: Price and payment will be full compensation for all pipe, grates when required, fasteners, reinforcing, connectors, anchors, concrete, sealants, jackets and coupling bands, and all work required.

430-12.9 Railroad Requirements: Where pipe culvert is constructed under railroad tracks, the Contract unit price for the pipe culvert will include the costs of any jacking operations and the operation of placing the pipe by use of a tunnel liner, (except as specified for unanticipated tunnel liner, in 430-6.5, where reimbursement is to be made for such unanticipated liner), and all other work necessary to meet the requirements of the railroad company, excluding the costs of watchman or flagman services provided by the railroad company, except as provided below.

The Department will reimburse the Contractor for the actual costs of any trestle bridge work which is performed by the railroad's forces, as billed to him by the railroad, less the value of any salvage materials derived there from, whether such salvage materials are retained by the railroad company or by the Contractor. When the work of shoring and bracing is to be performed by the railroad, such fact will be stipulated in the Contract Documents and the Contractor will be required to pay to the railroad the amount of such costs, which amount will be reimbursed to him by the Department. The Contract unit price for the pipe culvert shall include the costs of all other work of shoring and bracing.

430-12.10 Payment Items: Payment will be made under:

- Item No. 430-1 12-Inch ADS, N-11 - per Linear Foot (LF).*
- Item No. 430-2 18-Inch ADS, N-12 - per Linear Foot (LF).*
- Item No. 430-3 24-Inch ADS, N-12 - per Linear Foot (LF)*
- Item No. 430-4 18-Inch MES - per Each (EA)*

**SECTION 520
CONCRETE GUTTER, CURB ELEMENTS,
AND TRAFFIC SEPARATOR**

520-1 Description.

Construct Portland cement concrete curb and gutter, concrete traffic separator, valley gutter, special concrete gutter, and any other types of concrete curb not specified in other Sections.

520-2 Materials.

520-2.1 Concrete: Use concrete meeting the requirements of Section 347.

520-2.2 Reinforcement: For all steel reinforcement required by the plans, meet the requirements of Section 415.

520-2.3 Joint Materials: Meet the requirements of Section 932.

520-3 Forms.

520-3.1 Form Materials: Construct forms for this work of either wood or metal. Provide forms that are straight, free from warp or bends, and of sufficient strength, when staked, to resist the pressure of the concrete without deviation from line and grade. For all items constructed on a radius, use flexible forms.

520-3.2 Depth of Forms: Ensure that forms have a depth equal to the plan dimensions for the depth of concrete being deposited against them.

520-3.3 Machine Placement: The Contractor may place these items by machine methods with the approval of the Engineer provided that the Contractor consistently produces an acceptable finished product, true to line, grade, and cross section.

520-4 Excavation.

Excavate to the required depth, and compact the foundation material upon which these items are to be placed as specified in 120-9.

520-5 Placing Concrete.

Place the concrete in the forms, and tamp and spade it to prevent honeycombing, and until the top of the structure can be floated smooth and the edges rounded to the radius shown in the plans.

520-6 Joints.

520-6.1 Contraction Joints: Except for machine placed items, the Contractor may form joints by using dummy joints (either formed or sawed) or by using sheet metal templates. If using sheet metal templates, ensure that they are of the dimensions, and are set to the lines, shown in the plans. Hold templates firmly while placing the concrete. Leave templates in place until the concrete has set sufficiently to hold its shape, but remove them while the forms are still in place.

Saw contraction joints, for machine placed items, unless the Engineer approves an alternate method. Saw the joints as soon as the concrete has hardened to the degree that excessive raveling will not occur and before uncontrolled shrinkage cracking begins.

Space contraction joints at intervals of 10 feet except where closure requires a lesser interval, but do not allow any section to be less than 4 feet in length.

520-6.2 Expansion Joints: Construct expansion joints at all inlets, at all radius points, and at other locations indicated in the plans. Locate them at intervals of 500 feet between other expansion joints or ends of a run. Ensure that the joint is 1/2 inch in width.

520-7 Finishing.

520-7.1 Repair of Minor Defects: Remove the forms within 24 hours after placing the concrete, and then fill minor defects with mortar composed of one part portland cement and two parts fine aggregate. The Engineer will not allow plastering on the face of the curb. Remove and replace any rejected curb, curb and gutter, or valley gutter without additional compensation.

520-7.2 Final Finish: Finish all exposed surfaces while the concrete is still green. In general, the Engineer will only require a brush finish. For any surface areas, however, which are too rough or where other surface defects make additional finishing necessary, the Engineer may require the Contractor to rub the curb to a smooth surface with a soft brick or wood block, using water liberally. Also, if necessary to provide a suitable surface, the Engineer may require the Contractor to rub further, using thin grout or mortar.

520-8 Curing.

520-8.1 General: Continuously cure the concrete for a period of at least 72 hours. Commence curing after completely finishing and as soon as the concrete has hardened sufficiently to permit application of the curing material without marring the surface. Immediately replace any curing material removed or damaged during the 72 hour period.

After removing the forms, cure the surfaces exposed by placing a berm of moist earth against them or by any of the methods described below, for the remainder of the 72 hour curing period.

520-8.2 Wet Burlap Method: Place burlap, as specified in 925-1, over the entire exposed surface of the concrete, with sufficient extension beyond each side to ensure complete coverage. Overlap adjacent strips a minimum of 6 inches. Hold the burlap securely in place such that it will be in continuous contact with the concrete at all times, and do not allow any earth between the burlap surfaces at laps or between the burlap and the concrete. Saturate the burlap with water before placing it, and keep it thoroughly wet throughout the curing period.

520-8.3 Membrane Curing Compound Method: Apply clear membrane curing compound or white pigmented curing compound, as specified in 925-2, by a hand sprayer meeting the requirements of 350-3.10, in a single coat continuous film at a uniform coverage of at least one gallon per 200 square feet. Immediately recoat any cracks, checks, or other defects appearing in the coating. Thoroughly agitate the curing compound in the drum prior to application, and during application as necessary to prevent settlement of the pigment.

520-8.4 Polyethylene Sheeting Method: Place polyethylene sheeting, as specified in 925-3, over the entire exposed surface of the concrete, with sufficient extension beyond each side to ensure complete coverage. Overlap adjacent strips a minimum of 6 inches. Hold the sheeting securely in place and in continuous contact with the concrete at all times.

520-9 Backfilling and Compaction.

After the concrete has set sufficiently, but not later than three days after pouring, refill the spaces in front and back of the curb to the required elevation with suitable material. Place and thoroughly compact the material in layers not thicker than 6 inches.

520-10 Surface Requirements.

Test the gutter section of curb and gutter with a 10 foot straightedge laid parallel to the centerline of the roadway and while the concrete is still plastic. Perform straightedging along the edge of the gutter adjacent to the pavement or along other lines on the gutter cross-section, as directed by the Engineer. Immediately correct irregularities in excess of 1/4 inch.

520-11 Method of Measurement.

For curb or curb and gutter, the quantity to be paid will be plan quantity, in feet, measured along the face of the completed and accepted curb or curb and gutter.

For valley gutter or shoulder gutter, the quantity to be paid will be plan quantity, in feet, measured along the gutter line of the completed and accepted valley gutter or shoulder gutter.

For concrete traffic separator of constant width, the quantity to be paid will be plan quantity, in feet, measured along the center of its width, completed and accepted, including the length of the nose.

For concrete traffic separator of varying width, the quantity to be paid will be plan quantity, in square yards, completed and accepted.

520-12 Basis of Payment.

520-12.1 General: Price and payment will be full compensation for all work specified in this Section.

520-12.2 Excavation: Excavation will be paid for as Roadway Excavation in accordance with 120-12.2.

520-12.3 Reinforcement: Reinforcing steel will not be paid for separately. The Contractor shall include the cost of the steel in the Contract unit price for the item in which the steel is placed.

520-12.4 Joint Materials: The Contractor shall include the cost of all joint materials in the Contract unit price for the item in which they are used.

520-12.5 Asphalt Curb Pad: When detailed in the plans this material shall be included in the Contractors unit price for the item in which it is used.

520-12.6 Payment Items: Payment will be made under:

Item No. 520-1 Concrete Wheel Stop - per Each (EA)

**SECTION 522
CONCRETE SIDEWALK**

522-1 Description.

Construct concrete sidewalks.

522-2 Materials.

Meet the requirements specified in 520-2.

522-3 Forms.

Provide forms as specified in 520-3.

522-4 Foundation.

Compact fill areas, including cut areas under the sidewalk that have been excavated more than 6 inches below the bottom of sidewalk, to a minimum of 95% of AASHTO T 99 density. The area to be compacted is defined as that area directly under the sidewalk and 1 foot beyond each side of the sidewalk when right-of-way allows.

522-5 Joints.

522-5.1 Expansion Joints: Form 1/2 inch expansion joints between the sidewalk and the curb or driveway or at fixed objects and sidewalk intersections with a preformed joint filler meeting the requirements specified in 932-1.1.

522-5.2 Contraction Joints:

522-5.2.1 Types: The Contractor may use open type or sawed contraction joints.

522-5.2.2 Open-Type Joints: Form open type contraction joints by staking a metal bulkhead in place and depositing the concrete on both sides. After the concrete has set sufficiently to preserve the width and shape of the joint, remove the bulkhead. After finishing the sidewalk over the joint, edge the slot with a tool having a 1/2 inch radius.

522-5.2.3 Sawed Joints: If electing to saw the contraction joints, cut a slot approximately 3/16 inch wide and not less than 1 1/2 inches deep with a concrete saw after the concrete has set, and within the following periods of time:

Joints at not more than 30 feet intervals: within 12 hours after finishing.

Remaining joints: within 96 hours after finishing.

522-6 Placing Concrete.

Place the concrete as specified in 520-5.

522-7 Finishing.

522-7.1 Screeding: Strike-off the concrete by means of a wood or metal screed, used perpendicular to the forms, to obtain the required grade and remove surplus water and laitance.

522-7.2 Surface Requirements: Provide the concrete with a broom finish. Ensure that the surface variations are not more than 1/4 inch under a 10 foot straightedge, or more than 1/8 inch on a 5 foot transverse section. Finish the edge of the sidewalk with an edging tool having a radius of 1/2 inch.

522-8 Curing.

Cure the concrete as specified in 520-8.

522-9 Method of Measurement.

The quantity to be paid for will be plan quantity, in square yards, completed and accepted.

522-10 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section. Excavation will be paid for under the items for the grading work on the project.

Payment will be made under:

Item No. 522-1 Concrete Sidewalk - per Square Yard (SY).

**SECTION 527
DETECTABLE WARNINGS ON WALKING SURFACES**

527-1 Description.

Furnish and install Detectable Warning devices on newly constructed and/or existing concrete or asphalt walking surfaces (curb ramps, sidewalks, shared-use paths, etc.) constructed in accordance with the Design Standards Index No. 304.

527-2 Materials.

527-2.1 Detectable Warning: Provide Detectable Warnings in accordance with the Americans with Disabilities Act Standards for Transportation Facilities, Section 705. Use Detectable Warnings consisting of materials intended for exterior use subject to routine pedestrian traffic and occasional vehicular traffic. Use Detectable Warnings with size and pattern shown in the plans comprised of truncated domes aligned in parallel rows in accordance with the Design Standards, Index No. 304. Do not use detectable warnings with a diagonal pattern.

527-2.1.1 Preformed Materials: Use Detectable Warnings consisting of weather-resistant tiles or pavers that are cast into concrete, or tiles or mats that are surface-applied to concrete or asphalt surfaces with adhesives and mechanical fasteners or torch-applied preformed thermoplastic.

527-2.1.2 Field-Formed Materials: Use Detectable Warnings applied as a secondary application to the substrate.

527-2.2 Material Properties: Provide Detectable Warnings that meet the following minimum material property requirements when tested in accordance with the indicated Standard appropriate to the material.

PROPERTY	STANDARD	TEST VALUE
Slip Resistance	FM 3-C 1028	Dry Coefficient of Friction – 0.8 min. Wet Coefficient of Friction – 0.65 min. (include recessed areas between truncated domes)
Wear Resistance	FM 5-594	Average Volume Loss: no more than 0.06 cm ³
Water Absorption*	ASTM D-570	Not to exceed 5%.
Adhesion/Bond Strength**	FM 5-589	150 psi min. tensile adhesion strength
Non-Hazardous Classification	Submit Material Safety Data Sheet (MSDS)	Non-Hazardous, per RCRA Subtitle C
* Applies only to plastic materials.		
** Applies only to surface-applied materials.		

527-2.3 Color/Contrast: Use safety yellow, brick red or black colored Detectable Warnings on concrete walking surfaces. Use safety yellow colored Detectable Warnings on asphalt walking surfaces. Acceptable Detectable Warnings shall meet the following criteria for a duration of three years.

COLOR	LIGHT REFLECTANCE VALUES (LRV) CAP Y*
Safety Yellow	25 – 45
Brick Red	5 – 15
Black	0 – 5
*When measured with a spectrophotometer	

527-2.4 Qualified Products List: Methods or products used to form Detectable Warnings in wet concrete will not be permitted. Use Detectable Warnings listed on the Department's Qualified Products List (QPL). Manufacturers seeking evaluation of products for inclusion on the QPL shall submit an application in accordance with Section 6 and include certified test reports from an independent lab showing the product meets the requirements of this Section and the Design Standards, Index No. 304 Acceptance Criteria and manufacturer's drawings, specifications and procedures for materials and installation, including touch-up and repair.

527-3 Installation Procedures.

527-3.1 Surface Preparation and Installation: Prepare the surface in accordance with the manufacturer's recommendations. Use only products and materials appropriate for the surface on which they will be applied. Install in accordance with the manufacturer's instructions, using materials and equipment recommended and approved by the manufacturer. For surface-applied tiles or mats, use adhesives applied over the entire surface and mechanical fasteners.

527-4 Method of Measurement.

Detectable Warnings applied to newly constructed walking surfaces will be included in the cost of the walking surface. Detectable Warnings applied to existing walking surfaces will be paid per each location where Detectable Warnings are furnished, installed and accepted.

527-5 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section, including all labor, surface preparation, materials and incidentals necessary to complete the work for Detectable Warnings installed on existing walking surfaces.

Payment will be made under:

Item No. 527-1 Detectable Warning Surfaces – per Each (EA).

SECTION 700 HIGHWAY SIGNING

700-1 Description.

Furnish and erect aluminum or steel roadway signs, with supporting posts or columns, at the locations shown in the plans, in accordance with the details shown in the plans. Reflectorize all signs, and, when so specified in the plans, provide overhead signs with lighting.

The Department designates Ground Traffic Signs as all signs erected on the shoulders, slopes, or medians, but not extending over the traveled roadway.

The Department designates signs erected partially or completely over the traveled roadway or mounted on bridges as Overhead Traffic Signs, and may further classify some of these signs as Overhead Cantilever Traffic Signs.

700-2 Sign Assembly Design Requirements.

700-2.1 General: Sign assemblies as specified in the plans fall into two general categories: ground sign assemblies, and overhead sign assemblies.

Use any combination of sign materials described below. The Contractor may utilize different combinations for each type of sign assembly. However, ensure that the material combination used for each type is the same within the Contract.

700-2.2 Sign Panels: All sign panels shall be aluminum unless otherwise designated in the plans.

If using galvanized steel for the sign panels, provide the same dimensions, including the thickness, as those shown in the Contract Documents for aluminum.

Fabricate standard sign panel messages in accordance with details included in the Standard Highway Signs Manual published by the U.S. Department of Transportation. The Engineer will not require the submittal of shop drawings for these signs or for non-standard sign panels and messages fabricated in accordance with details shown in the plans. Submit seven copies of shop drawings indicating detailed layout of the sign legend, spacing, and border for all other signs to the Engineer prior to fabrication.

If the size of a sign is not specified in the plans, provide the size sign for conventional roadways as shown in the MUTCD.

700-2.3 Breakaway Support Mechanisms:

700-2.3.1 Frangible Supports: Provide posts for all frangible sign assemblies consisting of aluminum tubes up to 3 1/2 inches outside diameter with 3/16 inch wall thickness, or galvanized steel U-Channel up to 3 lb/ft as listed on the Qualified Products List (QPL).

700-2.3.2 Slip Bases: For posts with slip base assemblies, use either aluminum or galvanized steel in accordance with the requirements in the Design Standards. Alternative slip plane, plastic hinge, fracture elements, or combination sign support systems meeting the requirements of NCHRP 350 and Structures Manual wind load requirements may be used, subject to approval by the Department and listing on QPL. The QPL shall classify these systems as directional or omnidirectional systems.

700-2.4 Temporary Construction Sign Supports: Provide steel flanged U-channel consisting of rerolled rail steel or an equivalent billet steel, meeting the mechanical requirements of ASTM A 499, Grade 60, and meeting the chemical requirements of ASTM A 1. For each U-channel, punch or drill 3/8 inch diameter holes on 1 inch centers through the center of the post, starting approximately 1 inch from the top and extending the full length of the U-post.

Ensure that the weight per foot of a particular manufacturer's U-channel size does not vary more than $\pm 3\frac{1}{2}\%$ of its specified weight per foot. Taper the bottom end of the U-channel post for easier installation. Machine straighten the U-channel to a tolerance of 0.4% of the length. U-channel sign supports are listed on QPL.

Provide steel components that have been galvanized after fabrication in accordance with ASTM A 123 and have a smooth uniform finish free from defects affecting strength, durability, and appearance.

Attach the sign to the structural member using hardware meeting the manufacturer's recommendations and as specified in the Design Standards. Use attachment hardware (nuts, bolts, clamps, brackets, braces, etc.) of a non-corrosive metal, aluminum, or galvanized steel, meeting the vendor requirements specified on the QPL Drawings.

700-2.5 Overhead Sign Structures:

700-2.5.1 Department's Design: When the overhead sign structure is detailed in the plans, submit shop drawings to the Department for approval as specified in Section 5. Prior to the submittal of the shop drawings, determine the actual length of support columns for all sign structures on the basis of existing field conditions and include these lengths on the shop drawings.

700-2.5.2 Contractor's Design: When the overhead sign structure is not detailed in the plans, submit to the Department a foundation design and a sign structure design utilizing steel structural members. Meet the requirements of this Section and the FDOT Structures Manual.

Have designs and shop drawings prepared by a Specialty Engineer or the Contractor's Engineer of Record, and submit them to the Department for review and approval in accordance with Section 5.

Determine the actual length of support columns for all sign structures on the basis of existing field conditions, and include these lengths in the shop drawings and calculations.

700-2.5.3 Installation: Install nuts on anchor bolts in accordance with 649-5 and 649-6. Use ASTM A 325 bolt, nut and washer assemblies for all installations other than anchor bolts as follows. Use bolt, nut and washer assemblies that are free of rust and corrosion and that are lubricated properly as demonstrated by being able to easily hand turn the nut on the bolt thread for its entire length. Tighten nuts to the full effort of an ironworker using an ordinary spud wrench to bring the faying surfaces of the assembly into full contact which is referred to as snug tight condition. After bringing the faying surfaces of the assembly into full contact and to a snug tight condition, tighten nuts to achieve the minimum torque as specified in Table 700-1 unless the connection is an alternate splice connection of a span sign structure, in which case, tighten nuts in accordance with the turn-of-nut method of Table 460-7 of Section 460. Maintain uniform contact

pressure on the faying surfaces during snugging and the subsequent final tightening process, by using a bolt tightening pattern that balances the clamping force of each bolt, as closely as possible, with the equal clamping force of a companion bolt. Within 24 hours after final tightening, the Engineer will witness a check of the minimum torque using a calibrated torque wrench for 3 bolts or a minimum of 10% of the bolts, whichever is greater, for each connection; however, do not perform this check on alternate splice connections of span sign structures.

Table 700-1	
Bolt Diameter (in.)	Minimum Torque (ft.-lbs.)
3/8	15
1/2	37
5/8	74
3/4	120
7/8	190
1	275
1 1/8	375
1 1/4	525

700-2.6 Sign Background: Meet the requirements of Section 994. Use Type III, IV, V or VII sheeting for background sheeting, white legends, borders and shields on all signs, excluding STOP, DO NOT ENTER, and WRONG WAY. Use Type VII sheeting for STOP, DO NOT ENTER and WRONG WAY signs. Use Type III, IV, V or VII yellow-green fluorescent sheeting for S1-1 school advance signs and supplemental panels used with S1-1, S3-1 and S4-5 school signs. Do not mix signs having fluorescent yellow-green sheeting with signs having yellow reflective sheeting.

Use fluorescent orange Type VI or VII for all orange work zone signs.

Mesh signs shall meet the color, daytime luminance and nonreflective property requirements of Section 994, Type VI.

700-3 Materials.

700-3.1 General: Meet the materials requirements shown below and any additional requirements which the plans might show.

700-3.2 Concrete: For footings, use concrete meeting the requirements of Section 346.

700-3.3 Reinforcing Steel: For reinforcing steel in footings, meet the requirements of Section 415.

700-3.4 Aluminum Materials:

700-3.4.1 General: For aluminum materials, meet the general provisions of 965-1.

700-3.4.2 Sheets and Plates: For aluminum sheets and plates for sign panels, meet the requirements of ASTM B 209, Aluminum Association Alloy 6061-T6, 5154-H38 or 5052-H38 and those shown in the plans.

700-3.4.3 Extruded Tubing: For extruded aluminum tubing, meet the requirements shown in the plans.

700-3.4.4 Castings: Provide aluminum castings of the alloys shown in the plans. For aluminum alternates the Engineer will allow a cast base, provided the Contractor submits test reports giving evidence that the base to be used for each pole size is as strong as the pole with which it is to be used. Perform physical tests and submit certified reports for one base to be used with each pole size. Use Alloy A 356-T6 for the castings. Use aluminum bolts for connecting parts of the cast base.

700-3.4.5 Channels: For aluminum channels, meet the requirements of ASTM B 308 for the alloys shown in the plans.

700-3.4.6 Bolts, Nuts, and Lockwashers: For aluminum bolts, nuts, and lockwashers, meet the requirements shown in the plans. Ensure that finished bolts and washers are given an anodic coating of at least 0.0002 inch in thickness and are chromate-sealed.

700-3.5 Steel:

700-3.5.1 General: Only use structural steel, including bolts, nuts, and washers, that have been hot dip galvanized or metalized after fabrication. Perform hot dip galvanizing in accordance with ASTM A 123 or ASTM A 153 and metalizing in accordance with Section 562. For galvanized steel members, except plate for sign panels, meet the general requirements of Section 962 and the specific requirements of 962-9. For steel plate for use as sign panels, meet the requirements of ASTM A 283 for either Grade C or Grade D.

700-3.5.2 Specific Uses of Aluminum and Galvanized Steel: Use aluminum bolts, nuts, and hardware to connect parts of the cast base.

Use galvanized steel anchor bolts for anchoring base plates to concrete bases and for the nuts and washers.

For all other metal parts, the Engineer will allow galvanized steel as an alternate to aluminum.

700-3.6 Bearing Pads: For bearing pads, meet the requirements of 932-2.

700-3.7 Retroreflective Sheeting: All retroreflective sheeting must be listed on the QPL and meet the retroreflective sheeting requirements of Section 994.

700-3.8 Process Colors: Use transparent and black opaque process colors listed on the QPL meeting the requirements of 994-4 on retroreflective and nonreflective sheeting.

700-4 Preparation of Sign Blanks.

700-4.1 De-greasing and Etching for Aluminum Sign Blanks:

700-4.1.1 General: Prior to the application of reflective sheeting, use any of the methods shown below to de-grease and etch the aluminum sign blanks.

700-4.1.2 Hand Method: Under this method, de-grease and etch the blanks in one operation, using steel wool (medium grade) with any of the following combinations of materials:

- (1) An abrasive cleanser of a commercial grade kitchen scouring powder.
- (2) Acid and a suitable detergent solution.
- (3) An alkaline solution.

Thoroughly rinse the blanks with clean water following all hand de- greasing operations.

700-4.1.3 Power-Washer Method: Under this method, de-grease the blanks with an inhibited alkaline cleanser, by spraying for 90 seconds with the solution between 135 and 249°F, the exact temperature to be as recommended by the manufacturer of the cleanser. After the spraying, rinse the blanks with clean water. Then etch the blanks by immersing them in a 6 to 8% solution of phosphoric acid at a temperature of 100 to 180°F for 60 seconds. After immersion, rinse the blanks in clean water.

700-4.1.4 Immersion Method: Under this method, de-grease the blanks by immersing them in a solution of inhibited alkaline cleanser at a temperature between 160 and 180°F for three to five minutes, and then rinsing with clean water. Then etch blanks by immersing them in a 6 to 8% solution of phosphoric acid at a temperature of 100°F for three minutes. After immersion, rinse the blanks in clean water.

700-4.1.5 Vapor De-greasing Method: Under this method, de-grease the blanks by totally immersing them in a saturated vapor of trichloroethylene. Remove trademark printing with lacquer thinner or a controlled alkaline cleaning system.

700-4.1.6 Alkaline De-greasing Method: De-grease the blanks by totally immersing them in a tank containing an alkaline solution, controlled and titrated in accordance with the solution manufacturer's directions. Adapt immersion time to the amount of soil present and the thickness of the metal. After immersion, thoroughly rinse the blanks with running water.

700-4.1.7 Etching Method when De-greasing is Separate Operation: If using either of the de-greasing methods described under 700-4.1.5 and 700-4.1.6, accomplish etching by one of the following alternate methods:

- (1) Acid Etch: Etch well in a 6 to 8% phosphoric acid solution at 100°F, or in a proprietary acid etching solution. Rinse thoroughly with running cold water, which may be followed by a hot water rinse.
- (2) Alkaline Etch: Etch aluminum surfaces in an alkaline etching material that is controlled by titration. Meet the time, temperature, and concentration requirements specified by the solution manufacturer. After completing etching is complete, rinse the panel thoroughly.

700-4.2 Drying: Dry the panels using a forced-air drier. Use a device or clean canvas gloves, to handle the material between all cleaning and etching operations and the application of reflective sheeting. Do not allow the metal to come in contact with greases, oils or other contaminants prior to the application of reflective sheeting.

700-4.3 Fabrication of Sign Blanks: Fabricate all metal parts to ensure a proper fit of all sign components. Complete all fabrication, with the exception of cutting and punching of holes, prior to metal

de-greasing and applying the reflective sheeting. Cut metal panels to size and shape and keep free of buckles, warp, dents, burrs, and defects resulting from fabrication. Provide all sign panels with a flat surface. Where signs are to be fabricated from galvanized steel, cut the plates to the required size and drill prior to galvanizing.

700-5 Fabrication of Reflectorized Sign Faces.

700-5.1 Application of Sheeting: Apply reflective sheeting to the base panels with mechanical equipment in a manner specified for the manufacture of traffic control signs by the sheeting manufacturer. Ensure that sheeting applied to extruded aluminum sections adheres over and around the side legs of all panels to a minimum distance of 1/16 inch beyond the radius of top edge.

Match sign faces comprising two or more pieces of reflective sheeting for color and reflectivity at the time of sign fabrication. Reverse and apply consecutively alternate successive width sections of either sheeting or panels to ensure that corresponding edges of sheeting lie adjacent on the finished sign. The Engineer will not accept nonconformance that may result in non-uniform shading and an undesirable contrast between adjacent widths of applied sheeting.

700-5.2 Finish: Seal reflective sheeting splices and sign edges with materials the sheeting manufacturer supplies in a manner the sheeting manufacturer specifies for traffic control signs.

700-5.3 Screening-on Message: Screen message and borders on reflective sheeting in accordance with the recommendations of the ink or overlay manufacturer. Process either before or after applying the sheeting to the base panels.

700-5.4 Finished Sign Face: Provide finished signs with clean cut and sharp messages and borders. Ensure that finished background panels are essentially a plane surface.

700-5.5 Stenciling: For permanent roadway signs, mark the back of all finished panels at the bottom edge with "FDOT", the date of fabrication, the date of installation, and the fabricator's initials. For construction signs, mark the back of all finished panels at the bottom edge with the date of fabrication and the fabricator's initials. Make the markings unobtrusive, but legible enough to be easily read by an observer on the ground when the sign is in its final position. Apply the markings in a manner that is at least as durable as the sign face.

700-5.6 Product Changes: If changes in the formulation of the sheeting occur, submit new samples for re-evaluation for continued approval.

700-6 Acceptance of Signs.

700-6.1 Manufacturer's Certification and Recommendations: Ensure that the sign manufacturer certifies that the delivered signs conform to this Section and provides recommendations for storing and repairing signs.

700-6.2 Packaging and Shipping: Have the manufacturer package and ship the signs in a manner which will minimize possible damage.

700-6.3 Storage of Signs: If signs are stored prior to installation, store them in accordance with the manufacturer's recommendations.

700-6.4 Sign Inspection: Do not install signs until the Engineer inspects them for conformance with this Section. Provide all manufacturer certifications and recommendations prior to the Engineer's inspection. The Engineer will inspect the signs upon delivery to the storage or project site and again at the final construction inspection. Repair and replace signs deemed unacceptable by the Engineer at no expense to the Department.

700-6.5 Imperfections and Repairs: Repair and replace signs containing imperfections or damage regardless of the kind, type, or cause of the imperfections or damage. Make repairs according to the manufacturer's recommendations and to the satisfaction of the Engineer. Ensure that completed repairs provide a level of quality necessary to maintain the service life warranty of the sign and are satisfactory in appearance to the Engineer.

700-7 Footings for Signs, Posts and Supports.

700-7.1 Excavation and Backfilling: Perform excavation and backfilling for the footings in accordance with Section 125, with the exceptions that no specific density is required and that the backfill may be tamped in 4 inches maximum layers. Use material that is at near optimum moisture and neither dry or saturated, and tamp to the extent directed by the Engineer. The Department may require that the backfilling be done with poured concrete.

Install spread footings which support sign structures overhanging the roadway as required in 455-25 through 455-37.

700-7.2 Mixing and Placing Concrete: For batching and mixing of concrete for footings, meet the requirements of Section 346, except that the Engineer will allow hand mixing by approved methods where the quantity to be mixed does not exceed $1/2 \text{ yd}^3$. Use cast-in-place or precast concrete for the footings. Obtain precast concrete footings from a plant that is currently on the list of Producers with Accepted Quality Control Programs. Producers seeking inclusion on the list shall meet the requirements of 105-3.

700-7.3 Forms: The Engineer will not require forms when the ground is sufficiently firm, in which case, sufficiently moisten the adjacent earth to prevent it from absorbing the moisture from the concrete. Where forms are required and the soil is not moist, place sufficient water, as directed by the Engineer, in the hole, and pour the concrete as soon as the water has been absorbed. Place at least 4 inches of loose earth, free from clods or gravel, over the top of the footing to effect curing.

700-7.4 Finishing Concrete: Trowel the top of the concrete to a smooth finish.

700-8 Erection of Signs and Sign Supports.

Do not erect overhead sign supports until the concrete strength in the support footing is at least 2,500 psi. Determine concrete strength from tests on a minimum of two test cylinders sampled and tested in accordance with ASTM C 31 and ASTM C 39 and verifying test results have been provided to the Engineer.

Erect the signs and sign structures in accordance with the details shown in the plans. The Contractor may fabricate the structural steel sign trusses in sections that will fit into available galvanizing vats. Prior to galvanizing, weld the joints as specified in 460-6 and in accordance with the details shown in the plans. Re-galvanize damaged parts as specified in Section 562. Weld aluminum structures in accordance with 965-3.

700-9 Removal or Relocation of Signs.

Relocation of signs shall consist of removing the existing sign assembly and installing the sign on a new foundation.

When the plans call for existing ground-mounted signs to be relocated or removed, immediately remove supports and footings that project more than 6 inches above the ground surface after removing the sign panel from the assembly. Remove existing footings to a depth at least 12 inches below the ground surface. The costs will be included in the Contract unit price of the item to which it is incidental.

700-10 Overlay Existing Sign Panels.

Use 0.040-inch thick aluminum sheeting for overlays larger than 3 square feet placed on a sign panel. Replace hex head bolts on the sign surface using stainless steel flat head machine screws with nuts and lock washers to give a flat surface for the overlay panel. Install the overlay panels starting at the edge away from traffic. Place each panel against the sign using a clamp at the top to hold the panel in place. Drill 1/8-inch holes 1-inch inside the panel edge every 6-inches to 8-inches and install 1/4-inch to 3/8-inch length pop rivets. Install additional rivets along the outer edge 6-inches to 8-inches. Place the remaining panels using the same procedure with the overlap in the direction away from the traffic and with rivets along the overlap on 12-inch centers.

700- 11 Method of Measurement.

The quantities to be paid for will be:

- (1) The number of ground traffic signs of each designated class of assembly, complete.
- (2) The number of lighted overhead traffic signs of each designated class of assembly, complete.
- (3) The number of existing signs removed, relocated, modified of each designated class of assembly, complete.
- (4) The number of overhead signs span wire mounted, bridge mounted, and lighted sequential, of each designated class of assembly, complete.

For the purpose of payment, a sign assembly consists of all the signs mounted on a single structure (one, two or three posts, or overhead structure) or all the signs on a bridge mounted sign structure and the sign structure.

700-12 Basis of Payment.

Price and payment will be full compensation for furnishing and installation of all materials necessary to complete the signs in accordance with the details shown in the plans; including sign panels complete with sheeting, painting, and message; sign posts and supports, footings, excavation, etc.; for the lighted signs, all costs of the electrical installation for lighting, up to the point of connection by others; and all other work specified in this Section, including all incidentals necessary for the complete item.

700-12.1 Payment Items: Payment will be made under:

Item No. 700-1 Vehicular Signage - per Lump Sum (LS)

**SECTION 710
PAINTED PAVEMENT MARKINGS**

710-1 Description.

Apply Painted Traffic Stripes and Markings, in accordance with the Contract Documents.

710-2 Materials.

Use only materials listed on the Qualified Products List (QPL) meeting the following requirements:

Raised Retro-reflective Pavement Markers and Bituminous Adhesive.....	Section 970
Standard Waterborne Fast Dry Traffic Paint	971-1 and 971-3
Fast Dry Solvent Paint	971-1 and 971-4
Glass Spheres.....	971-1 and 971-2

The Engineer will take random samples of all material in accordance with the Department's Sampling, Testing and Reporting Guide schedule.

710-3 Equipment.

Use equipment that will produce continuous uniform dimensions of pavement markings of varying widths and meet the following requirements:

- (a) Capable of traveling at a uniform, predetermined rate of speed, both uphill and downhill, in order to produce a uniform application of paint and capable of following straight lines and making normal curves in a true arc.
- (b) Capable of applying glass spheres to the surface of the completed stripe by an automatic sphere dispenser attached to the striping machine such that the glass spheres are dispensed closely behind the installed line. Use a glass spheres dispenser equipped with an automatic cut-off control that is synchronized with the cut-off of the traffic paint and applies the glass spheres in a manner such that the spheres appear uniform on the entire pavement markings surface with, 50 to 60% embedment.
- (c) Capable of spraying the paint to the required thickness and width without thinning of the paint. Equip the paint tank with nozzles equipped with cut-off valves, which will apply broken or skip lines automatically.

710-4 Application:

710-4.1 General: Remove existing pavement markings, such that scars or traces of removed markings will not conflict with new pavement markings, by a method approved by the Engineer. Payment for marking removal will be in accordance with 102-5.8.

Before applying traffic stripes and markings, remove any material by a method approved by the Engineer that would adversely affect the bond of the traffic stripes.

Apply traffic stripes and markings only to dry surfaces, and when the ambient air and surface temperature is at least 40°F and rising. Do not apply traffic stripes and markings when winds are sufficient to cause spray dust.

Apply traffic stripes and markings, having well defined edges, over existing pavement markings such that not more than 2 inches on either end and not more than 1 inch on either side is visible.

Mix the paint thoroughly prior to pouring into the painting machine. Apply paint to the pavement by spray or other means approved by the Engineer.

Conduct field testing in accordance with FM 5-541. Remove and replace traffic stripes and markings not meeting the requirements of this Section at no additional cost to the Department.

Apply all pavement markings prior to opening the road to traffic.

710-4.1.1 Final Surface: Painted Pavement Markings (Final Surface) will include two applications of standard painted pavement markings and one application of retro-reflective pavement markers applied to the final surface. Wait at least 14 days after the first application to apply the second application of Painted Pavement Markings (Final Surface). Second application must be applied prior to final acceptance of the project.

Apply all retro-reflective pavement markers per the requirements of FDOT Specification Section 706.

710-4.2 Thickness: Apply paint to attain a minimum wet film thickness in accordance with the manufacturer's recommendations.

710-4.3 Retroreflectivity: Apply white and yellow standard pavement markings that will attain an initial retroreflectance of not less than 300 mcd/lx·m² and not less than 250 mcd/lx·m², respectively. Measure, record and certify on a Department approved form and submit to the Engineer, the retroreflectivity of white and yellow pavement markings in accordance with Florida Method FM 5-541.

The Department reserves the right to test the markings within 3 days of receipt of the Contractor's certification. Failure to afford the Department opportunity to test the markings will result in non-payment. The test readings should be representative of the Contractor's striping performance. If the retroreflectivity values measure below values shown above, reapply the striping at no additional cost to the Department.

For standard pavement markings, ensure that the minimum retroreflectance of white and yellow pavement markings are not less than 150 mcd/lx m². If the retroreflectivity values fall below the 150 mcd/lx m² value within six months of initial application, the striping will be reapplied at the Contractor's expense.

710-4.4 Color: Use paint material that meets the requirements of 971-1.

710-4.5 Glass Spheres: Apply glass spheres on all pavement markings immediately and uniformly following the paint application. The rate of application shall be based on the manufacturer's recommendation.

710-5 Tolerances in Dimensions and in Alignment.

Establish tack points at appropriate intervals for use in aligning stripes, and set a stringline from such points to achieve accuracy.

710-5.1 Dimensions:

710-5.1.1 Longitudinal Lines: Apply painted skip line segments with no more than ±12 inches variance, so that over-tolerance and under-tolerance lengths between skip line and the gap will

approximately balance. Apply longitudinal lines at least 2 inches from construction joints of portland cement concrete pavement.

710-5.1.2 Transverse Markings, Gore Markings, Arrows, and Messages: Apply paint in multiple passes when the marking cannot be completed in one pass, with an overall line width allowable tolerance of ± 1 inch

710-5.1.3 Contrast Lines: Use black paint to provide contrast on concrete or light asphalt pavement, when specified by the Engineer. Apply black paint in 10 foot segments following each longitudinal skip line.

710-5.2 Alignment: Apply painted stripes that will not deviate more than 1 inch from the stringline on tangents and curves one degree or less. Apply painted stripes that will not deviate more than 2 inches from the stringline on curves greater than one degree. Apply painted edge stripes uniformly, not less than 2 inches or more than 4 inches from the edge of pavement, without noticeable breaks or deviations in alignment or width.

Remove and replace at no additional cost to the Department, traffic stripes that deviate more than the above stated requirements.

710-5.3 Correction Rates: Make corrections of variations in width at a maximum rate of 10 feet for each 0.5 inches of correction. Make corrections of variations in alignment at a maximum rate of 25 feet for each 1 inch of correction, to return to the stringline.

710-6 Contractor's Responsibility for Notification.

Notify the Engineer prior to the placement of the materials. Furnish the Engineer with the manufacturer's name and batch numbers of the materials and glass spheres to be used. Ensure that the approved batch numbers appear on the materials and glass spheres packages.

710-7 Protection of Newly Painted Pavement Markings.

Do not allow traffic onto or permit vehicles to cross newly applied pavement markings until they are sufficiently dry. Remove and replace any portion of the pavement markings damaged by passing traffic or from any other cause, at no additional cost to the Department.

710-8 Corrections for Deficiencies to Applied Painted Pavement Markings.

Reapply a 1.0 mile section centered around any deficiency, at no additional cost to the Department.

710-9 Submittals.

710-9.1 Submittal Instructions: Prepare a certification of quantities, using the Department's current approved form, for each project in the Contract. Submit the certification of quantities and daily worksheets to the Engineer. The Department will not pay for any disputed items until the Engineer approves the certification of quantities.

710-9.2 Contractor's Certification of Quantities: Request payment by submitting a certification of quantities no later than Twelve O'clock noon Monday after the estimate cut-off date or as directed by the Engineer, based on the amount of work done or completed. Ensure the certification of quantities consists of the following:

- (a) Contract Number, FPID Number, Certification Number, Certification Date and the period that the certification represents.

- (b) The basis for arriving at the amount of the progress certification, less payments previously made and less any amount previously retained or withheld. The basis will include a detailed breakdown provided on the certification of items of payment.

710-10 Method of Measurement.

The quantities to be paid for under this Section will be as follows:

- (a) The length, in net miles, of 6 inch Solid Traffic Stripe, authorized and acceptably applied.
- (b) The total traversed distance in gross miles of 10-30 or 3-9 skip line. The actual applied line is 25% of the traverse distance for a 1:3 ratio. This equates to 1,320 feet of marking per mile of single line.
- (c) The net length, in feet, of each of all other types of lines and stripes, authorized and acceptably applied.
- (d) The number of pavement messages, symbols and directional arrows, authorized and acceptably applied.
- (e) Lump Sum, as specified in 710-4.1.1 when the item for Painted Pavement Markings (Final Surface) is included in the proposal.

The net length, in feet of dotted and skip stripes other than 10-30 and 3-9 will be measured as the distance from the beginning of the first painted stripe to the end of the last painted stripe with proper deductions made for unpainted intervals as determined by plan dimensions or stations, subject to 9-1.3. Unpainted intervals will not be included in pay quantity.

The gross-mile measurement of 10-30 and 3-9 Skip Traffic Stripes will be taken as the distance from the beginning of the first painted stripe to the end of the last painted stripe, and will include the unpainted intervals. It will not include any lengths of unpainted intervals which, by design or by other intent of the Department, are greater than 30 feet. Final measurement will be determined by plan dimensions or stations, subject to 9-1.3.1.

710-11 Basis of Payment.

710-11.1 General: Prices and payments will be full compensation for all work specified in this Section, including, all cleaning and preparing of surfaces, furnishing of all materials, application, curing and protection of all items, protection of traffic, furnishing of all tools, machines and equipment, and all incidentals necessary to complete the work. Final payment will be withheld until all deficiencies are corrected.

710-11.2 Lump Sum Payment: When the item for Painted Pavement Markings (Final Surface) is included in the proposal, prices and payments will be full compensation for two applications of all painted pavement markings applied to the final surface, and one application of retro-reflective pavement markers applied to the final surface in accordance with FDOT Specification Section 706.

Payment will be made under:

Item No. 710-1 Vehicular Pavement Markings, White – per Square Foot (SF)

Item No. 710-2 Vehicular Pavement Markings, Blue – per Square Foot (SF)

**SECTION 711
THERMOPLASTIC TRAFFIC STRIPES AND MARKINGS**

711-1 Description.

Apply new thermoplastic traffic stripes and markings, or refurbish existing thermoplastic traffic stripes and markings, in accordance with the Contract Documents.

711-2 Materials.

711-2.1 Thermoplastic: Use only thermoplastic materials listed on the Qualified Products List (QPL). The Engineer will take random samples of all material in accordance with the Department's Sampling, Testing and Reporting Guide schedule.

711-2.1.1 Initial or Recapped Stripes and Markings: Use materials meeting the requirements of 971-1 and 971-5.

711-2.1.2 Refurbishing Existing Stripes and Markings: Use materials meeting the requirements of 971-1 and 971-5.

711-2.1.3 Preformed Stripes and Markings: Use Materials meeting the requirements of 971-1 and 971-6.

711-2.2 Glass Spheres: Use only glass spheres listed on the Qualified Products List (QPL), meeting the requirements of 971-1 and 971-2 (Current FDOT Specifications). The Engineer will take random samples of all glass spheres in accordance with ASTM D 1214 and the Department's Sampling, Testing and Reporting Guide schedule.

711-2.3 Sand: Sharp silica sand used for bike lane symbols and pedestrian crosswalk lines shall meet the following gradation requirements:

Sieve Size	% Passing
20	100
50	0 to 10

711-3 Equipment.

Use equipment capable of providing continuous uniform heating of striping materials to temperatures exceeding 390°F, mixing and agitation of the material reservoir to provide a homogeneous mixture without segregation. Use equipment that will maintain the striping material in a plastic state, in all mixing and conveying parts, including the line dispensing device until applied. Use equipment which can produce varying width traffic stripes and which meets the following requirements:

- (a) capable of traveling at a uniform, predetermined rate of speed, both uphill and downhill, in order to produce a uniform application of striping material and capable of following straight lines and making normal curves in a true arc.
- (b) is capable of applying glass spheres to the surface of the completed stripe by a double drop application for initial traffic striping and marking and a single drop application for recapping and refurbishing. The bead dispenser for the first bead drop shall be attached to the striping machine in such a manner that the beads are dispensed closely behind with the thermoplastic material. The second bead

dispenser bead shall be attached to the striping machine in such a manner that the beads are dispensed immediately after the first bead drop application. Glass spheres dispensers shall be equipped with an automatic cut-off control that is synchronized with the cut-off of the thermoplastic material and applies the glass spheres in a manner such that the spheres appear uniform on the entire traffic stripes and markings surface with, 50 to 60% embedment.

- (c) equipped with a special kettle for uniformly heating and melting the striping material. The kettle must be equipped with an automatic temperature control device and material thermometer for positive temperature control and to prevent overheating or scorching of the thermoplastic material.
- (d) meet the requirements of the National Fire Protection Association, state, and local authorities.

711-4 Application.

711-4.1 General: Remove existing pavement markings such that scars or traces of removed markings will not conflict with new stripes and markings by a method approved by the Engineer. Cost for removing conflicting pavement markings during maintenance of traffic operations to be included in Maintenance of Traffic, Lump Sum.

Before applying traffic stripes and markings, remove any material by a method approved by the Engineer that would adversely affect the bond of the traffic stripes. Before applying traffic stripes to any Portland cement concrete surface, apply a primer, sealer or surface preparation adhesive of the type recommended by the manufacturer. Offset longitudinal lines at least 2 inches from any longitudinal joints of Portland cement concrete pavement.

Apply traffic stripes or markings only to dry surfaces, and when the ambient air and surface temperature is at least 50°F and rising for asphalt surfaces and 60°F and rising for concrete surfaces.

Apply striping to the same tolerances in dimensions and in alignment specified in 710-5. When applying traffic stripes and markings over existing markings, ensure that not more than 2 inches on either end and not more than 1 inch on either side of the existing line is visible.

Apply thermoplastic material to the pavement either by spray, extrusion or other means approved by the Engineer.

Conduct field tests in accordance with FM 5-541. Take test readings representative of the striping performance. Remove and replace traffic stripes and markings not meeting the requirements of this Section at no additional cost to the Department.

Apply all final pavement markings prior to opening the road to traffic.

711-4.1.1 Preformed Thermoplastic: Apply markings only to dry surfaces and when ambient air temperature is at least 32°F. Prior to installation, follow the manufacturer's recommendations for pre-heating.

711-4.2 Thickness:

711-4.2.1 Initial or Recapped Stripes and Markings: Apply or recap traffic stripes or markings such that all lane lines, center lines, transverse markings and traffic stripes and markings within

traffic wearing areas, will have a thickness of 0.10 to 0.15 inch when measured above the pavement surface.

Also, all gore, island, and diagonal stripe markings, bike lane symbols and messages, wherever located, will have a thickness of 0.09 to 0.12 inch when measured above the pavement surface.

Measure, record and certify on Department approved form and submit to the Engineer, the thickness of white and yellow pavement markings in accordance with Florida Method FM 5-541.

711-4.2.2 Refurbishing Existing Traffic Stripes and Markings: Apply a minimum of 0.06 inch of thermoplastic material. Ensure that the combination of the existing stripe and the overlay after application of glass spheres does not exceed the maximum thickness of 0.150 inch for all lines.

711-4.3 Retroreflectivity: Apply white and yellow traffic stripes and markings that will attain an initial retroreflectivity of not less than 450 mcd/lx·m² and not less than 350 mcd/lx·m², respectively for all longitudinal lines. All transverse lines, messages and arrows will attain an initial retroreflectivity of not less than 300 mcd/lx·m² and 250 mcd/lx·m² for white and yellow respectively. All pedestrian crosswalks, bike lane symbols or messages in a proposed bike lane shall attain an initial retroreflectivity of not less than 275 mcd/lx·m².

Measure, record and certify on Department approved form and submit to the Engineer, the retroreflectivity of white and yellow pavement markings in accordance with Florida Method FM 5-541.

711-4.4 Glass Spheres:

711-4.4.1 Longitudinal Lines: For initial traffic striping and marking, apply the first drop of Type 4 or larger glass spheres immediately followed by the second drop of Type 1 glass spheres. For refurbishing, apply a single drop of Type 3 glass spheres. Apply reflective glass spheres to all markings at the rates determined by the manufacturer's recommendations.

711-4.4.2 Transverse Stripes and Markings: Apply a single drop of Type 1 glass spheres. Apply reflective glass spheres to all markings at the rates determined by the manufacturer's recommendations.

Apply a mixture consisting of 50% glass spheres and 50% sharp silica sand to all thermoplastic pedestrian crosswalk lines and bike lane symbols at the rates determined by the manufacturer's recommendations.

711-4.4.3 Preformed Markings: These markings are factory supplied with glass spheres and skid resistant material. No additional glass spheres or skid resistant material should be applied during installation.

711-5 Contractor's Responsibility for Notification.

Notify the Engineer prior to the placement of the thermoplastic materials. Furnish the Engineer with the manufacturer's name and batch numbers of the thermoplastic materials and glass spheres to be used. Ensure that the approved batch numbers appear on the thermoplastic materials and glass spheres packages.

711-6 Protection of Newly Applied Traffic Stripes and Markings.

Do not allow traffic onto or permit vehicles to cross newly applied pavement markings until they are sufficiently dry. Remove and replace any portion of the pavement markings damaged by passing traffic or from any other cause, at no additional cost to the Department

711-7 Observation Period.

Pavement markings are subject to a 180 day observation period under normal traffic. The observation period shall begin with the satisfactory completion and acceptance of the work.

The pavement markings shall show no signs of failure due to blistering, excessive cracking, chipping, discoloration, poor adhesion to the pavement, loss of reflectivity or vehicular damage. The retroreflectivity shall meet the initial requirements of 711-4.3. The Department reserves the right to check the color and retroreflectivity any time prior to the end of the observation period.

Replace, at no additional expense to the Department, any pavement markings that do not perform satisfactorily under traffic during the 180 day observation period.

711-8 Corrections for Deficiencies.

Recapping applies to conditions where additional striping material is applied to new or refurbished traffic stripes or markings to correct a deficiency. Recap a 1.0 mile section centered around the deficiency with additional striping material or by complete removal and reapplication at no additional cost to the Department.

If recapping will result in a thickness exceeding the maximum allowed, the traffic stripes or markings will be removed and reapplied.

711-9 Submittals.

711-9.1 Submittal Instructions: Prepare a certification of quantities, using the Department's current approved form, for each project in the Contract. Submit the certification of quantities and daily worksheets to the Engineer. The Department will not pay for any disputed items until the Engineer approves the certification of quantities.

711-9.2 Contractor's Certification of Quantities: Request payment by submitting a certification of quantities no later than Twelve O clock noon Monday after the estimate cut-off date or as directed by the Engineer, based on the amount of work done or completed. Ensure the certification of quantities consists of the following:

- (a) Contract Number, FPID Number, Certification Number, Certification Date and the period that the certification represents.
- (b) The basis for arriving at the amount of the progress certification, less payments previously made and less any amount previously retained or withheld. The basis will include a detailed breakdown provided on the certification of items of payment.

711-10 Method of Measurement.

The quantities to be paid for under this Section will be as follows:

- (a) The length, in net miles, of 6 inch Solid Traffic Stripe, authorized and acceptably applied.

- (b) The total traversed distance in gross miles of 10-30 or 3-9 skip line. The actual applied line is 25% of the traverse distance, for a 1:3 ratio. This equates to 1,320 feet of marking per mile of single line.
- (c) The net length, in feet, of all other types of lines and stripes, authorized and acceptably applied.
- (d) The area, in square feet, of Removal of Existing Pavement Markings, acceptably removed.
- (e) The number of pavement messages, symbols and directional arrows, authorized and acceptably applied.

711-11 Basis of Payment.

Prices and payments will be full compensation for all work specified in this Section, including, all cleaning and preparing of surfaces, furnishing of all materials, application, curing and protection of all items, protection of traffic, furnishing of all tools, machines and equipment, and all incidentals necessary to complete the work. Final payment will be withheld until all deficiencies are corrected.

Payment will be made under:

- Item No. 711-1 Thermoplastic, Standard, White, Solid, 24" – per Linear Foot (LF)*
- Item No. 711-2 Handicap Parking Symbol – per Each (EA)*

SECTION 981 TURF MATERIALS

981-1 General.

The types of seed and sod will be specified in the Contract Documents. All seed and sod shall meet the requirements of the Florida Department of Agriculture and Consumer Services and all applicable state laws, and shall be approved by the Engineer before installation.

All seed, sod and mulch shall be free of noxious weeds and exotic pest plants, plant parts or seed listed in the current Category I "List of Invasive Species" from the Florida Exotic Pest Plant Council (FLEPPC, www.fleppc.org). Any plant officially listed as being noxious or undesirable by any Federal Agency, any agency of the State of Florida or any local jurisdiction in which the project is being constructed shall not be used. Furnish to the Engineer, prior to incorporation onto the project, a certification from the Florida Department of Agriculture and Consumer Services, Division of Plant Industry, stating that the seed, sod or mulch materials are free of noxious weeds. Any such noxious or invasive plant or plant part found to be delivered in seed, sod or mulch will be removed by the Contractor at his expense and in accordance with the law.

All materials shall meet plant quarantine and certification entry requirements of Florida Department of Agriculture & Consumer Services, Division of Plant Industry Rules.

981-2 Seed.

The seed shall have been harvested from the previous year's crop. All seed bags shall have a label attached stating the date of harvest, LOT number, percent purity, percent germination, noxious weed certification and date of test.

Each of the species or varieties of seed shall be furnished and delivered in separate labeled bags. During handling and storing, the seed shall be cared for in such a manner that it will be protected from damage by heat, moisture, rodents and other causes.

All permanent and temporary turf seed shall have been tested within a period of six months of the date of planting.

All permanent and temporary turf seed shall have a minimum percent of purity and germination as follows:

1. All Bahia seed shall have a minimum pure live seed content of 95% with a minimum germination of 80%.
2. Bermuda seed shall be of common variety with a minimum pure live seed content of 95% with a minimum germination of 85%.
3. Annual Type Ryegrass seed shall have a minimum pure live seed content of
4. 95% with a minimum germination of 90%.

981-3 Sod.

981-3.1 Types: Unless a particular type of sod is called for in the Contract Documents, sod may be either centipede, bahia, or bermuda at the Contractor's option. It shall be well matted with roots. Where sodding will adjoin, or be in sufficiently close proximity to, private lawns, other types of sod may be used if desired by the affected property owners and approved by the Engineer.

981-3.2 Dimensions: The sod shall be taken up in commercial-size rectangles, or rolls, preferably 12 by 24 inch or larger, except where 6 inch strip sodding is called for, or as rolled sod at least 12 inches in width and length consistent with the equipment and methods used to handle the rolls and place the sod. Sod shall be a minimum of 1 1/4 inch thick including a 3/4 inch thick layer of roots and topsoil. Reducing the width of rolled sod is not permitted after the sod has been taken up from the initial growing location. Any netting contained within the sod shall be certified by the manufacturer to be bio-degradable within a period of three months from installation.

981-3.3 Condition: The sod shall be sufficiently thick to secure a dense stand of live turf. The sod shall be live, fresh and uninjured, at the time of planting. It shall have a soil mat of sufficient thickness adhering firmly to the roots to withstand all necessary handling. It shall be planted within 48 hours after being cut and kept moist from the time it is cut until it is planted. No sod which has been cut for more than 48 hours may be used unless specifically authorized by the Engineer. A letter of certification from the turf Contractor as to when the sod was cut, and what type, shall be provided to the Engineer upon delivery of the sod to the job site.

The source of the sod may be inspected and approved by the Engineer prior to being cut for use in the work.

981-4 Mulch.

The mulch material shall be compost meeting the requirements of Section 987, hardwood barks, shavings or chips; or inorganic mulch materials as approved by the Engineer; or hydraulically applied wood fiber mulch or bonded fiber matrix (BFM).

981-5 Source Requirements for Sod and Mulch.

The Contractor shall comply with all current restrictions in regard to movement of sod and mulch material, as required by the Division of Plant Industry, Florida Department of Agriculture and Consumer Services (www.doacs.state.fl.us/pi/plantinsp/pi_reg_summary.html).

981-5.1 Payment Items: Payment will be made under:

<i>Item No. 981-1</i>	<i>Centipede Sod-Commercial Hangar - per Square Yard (SY)</i>
<i>Item No. 981-2</i>	<i>Centipede Sod-North Hangar - per Square Yard (SY)</i>
<i>Item No. 981-3</i>	<i>Centipede Sod-South Hangar - per Square Yard (SY)</i>

SECTION 02660

WATER DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This item consists of furnishing all labor, materials, equipment and incidentals required for the installation of new waterline as required by the Contract Documents, including all piping, fittings, and appurtenances for water distribution.
- B. The work generally includes on-site underground potable water mains (with or without fire hydrants), below grade mechanical piping and other miscellaneous work as depicted on the drawings or specified herein.
- C. General Design. The equipment and materials specified herein is intended to be standard types of pipe, fittings and appurtenances for use in transporting water.
- D. The below listed standards are applicable and are adopted by reference:
 - 1. ANSI/AWWA C104/A21.4 Cement-Motor Lining for Ductile-Iron Pipe and fittings for Water
 - 2. ANSI/AWWA C110/A21.10 Ductile-Iron and Gray-Iron Fittings, 3 in. through 48 in., for Water and Other Liquids.
 - 3. ANSI/AWWA C111/A21.11 Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.
 - 4. ANSI/AWWA C115/A21.15 Flanged Ductile-Iron Pipe with Threaded Flanges.
 - 5. ANSI/AWWA C150/A21.50 Thickness Design of Ductile-Iron Pipe.
 - 6. ANSI/AWWA C151/A21.51 Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds for Water or Other Liquids.
 - 7. ANSI/AWWA C153/A21.53 Ductile-Iron Compact Fittings, 3 in. Through 16 in, for Water and Other Liquids.
 - 8. ANSI/AWWA C503 Wet-Barrel Fire Hydrants.
 - 9. ANSI/AWWA C506 Back flow Prevention Devices – Reduced Pressure Principal and Double Check Valve Types
 - 10. ANSI/AWWA C508 Swing-Check Valves for Water Works Service – 2 inches through 24 inches.
 - 11. ANSI/AWWA C509 Resilient- Seated Gate Valves for Water Supply Service.
 - 12. ANSI/AWWA C511 Reduced-Pressure Principal Backflow- Prevention Assembly
 - 13. ANSI/AWWA C600 Installation of Ductile Iron Water Mains and their Appurtenances.
 - 14. ANSI/AWWA C605 Underground Installation of Poly Vinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
 - 15. ANSI/AWWA C651 Disinfecting Water Mains
 - 16. ANSI/AWWA C702 Cold - Water Meters - Compound Type
 - 17. ANSI/AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe, 4 inches through 12 inches.

- | | |
|--------------------|--|
| 18. ANSI/AWWA C905 | Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 inches through 36 inches. |
| 19. ASTM D2241 | *Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR) |
| 20. ASTM F477 | *Elastomeric Seals (Gaskets) for Joining Plastic Pipe. |

1.02 QUALITY ASSURANCE

- A. Qualifications. All of the pipe, fittings and appurtenances shall be furnished by manufacturers who are fully experienced, reputable, and qualified in the manufacture of the materials to be furnished. The pipe, fittings and appurtenances shall be designed, constructed, and installed in accordance with the best practices and methods and shall comply with the adapted references and these specifications as applicable.
- B. Manufacturers of Ductile Iron Pipe and Fitting will be the American Cast Iron Pipe Company, U.S. Pipe and Foundry Company, McWane Cast Iron Pipe Company or Owner approved equal.
- C. Factory Tests for DIP and DI Fittings: The manufacturer shall perform the factory tests described in ANSI/AWWA C151/A-21.51 and shall submit sworn certifications of the factory tests and their results.
- D. PVC pipe shall be manufactured by Certain Teed, Diamond Plastics, Eslon, J-M Pipe, North American Pipe Corp., or equal.
- E. PVC compounds shall be Class 12454A or 12454B in accordance with ASTM D1784. The manufacturer(s) of pipe supplied for this project shall provide a compliance statement for the following and for all other qualifications required by this specification as applicable.
 - 1. Cell Classification Tests (ASTM D1784)
 - 2. Hydrostatic Design Stress Testing (ASTM D2837)
 - 3. Quick Burst Testing (ASTM D1599)
 - 4. Pipe Impact Testing (ASTM D2444)
 - 5. Pipe Stiffness Testing and Flattening Testing (ASTM D2412)
 - 6. Sustained Pressure Testing (ASTM D1598 and ASTM D2241)
 - 7. Hydrostatic Proof Testing (ANSI/AWWA C900)
- F. Quality Control. The manufacturer shall establish the necessary quality control and inspection practice to ensure compliance with the referenced standards and shall provide written warranty for their products.
- G. All new and relocated project components that will come into contact with drinking water or drinking water treatment chemicals (except components that will come into contact with raw water prior to its treatment by reverse osmosis) will be in conformance with American National Standards Institute/NSF International (ANSI/NSF) Standard 61. Also, all drinking water treatment chemicals supplied under this project except fluoridation chemicals will be in conformance with ANSI/NSF Standard 60 and all fluoridation chemicals supplied under this project will be in conformance with ANSI and American Water Works Association

Standard B701, B702, or B703 as applicable.

1.03 SUBMITTALS

- A. Within seven (7) days after execution of the Contract, submit a list of materials, names of manufacturers and dates of delivery of materials to the project site.
- B. Shop and Layout Drawings.
 - 1. Submit complete shop drawings detailing all of the technical and dimensional data of material to be furnished including weights.
 - 2. Submit layout drawings including restrained joint layouts, fitting and joint layouts, and mechanical piping layouts with support locations. Layout drawings shall be prepared to an appropriate scale with dimensioning.
- C. Submit Manufacturer Certifications as required by these specifications.
- D. Submit Florida Licensed Surveyor Certified As-built drawings of water mains and piping with verified vertical and horizontal data as required by these specifications.
- E. Submit documentation for all tests required by these specifications.

PART 2 - PRODUCTS

2.01 MECHANICAL JOINT & PUSH-ON JOINT DUCTILE IRON PIPE AND FITTINGS

- A. Pipe shall conform to the requirements of ANSI/AWWA C151/A21.51 with thickness design in accordance with ANSI/AWWA C150/A21-50, latest editions. All pipes shall be tested and marked in accordance with these standards. Pipe diameters equal to or less than 12 inches shall be minimum pressure Class 350 psi.
- B. Pipe for installation below ground shall be supplied in lengths not in excess of a nominal 20 feet. The pipe shall have either mechanical joint or push-on joints with rubber gaskets in accordance with ANSI/AWWA C111/A21.11.
- C. Fittings shall be ductile iron or cast iron mechanical joint in accordance with ANSI/AWWA C110/A21.10 with a minimum pressure rating as follows: 350 psi for pipe diameters through 24 inches.
- D. In lieu of the above requirement compact ductile iron mechanical joint fittings in accordance with ANSI/AWWA C153/A21.53 may be used for pipe diameters 12 inches and smaller; minimum pressure Class 350 psi.
- E. Rubber gaskets for joints and fittings shall be made of vulcanized styrene butadiene rubber (SBR) in accordance with ANSI/AWWA C111/A21.11. Tee head nuts and bolts for mechanical joints shall also comply with this standard.
- F. Push-on joint pipe joints shall be in accordance with the applicable parts of ANSI/AWWA C111/A21.11 and shall be American Standard, Fastite type or equal.

2.02 FLANGED JOINT DUCTILE IRON PIPE AND FITTINGS

- A. All above grade pipe and pipe inside pits, tanks, and pump station structures shall be flanged ductile iron pipe conforming to ANSI/AWWA C115/A21.15, latest edition with a minimum special thickness class of 53.
1. Minimum dimension for flanged pipe shall be as shown in **Table 2.1**.
 2. Ductile iron pipe barrels for threaded flanged pipe shall conform to the requirements of ANSI/AWWA C151/A21.51 with taper pipe threads for flanges in accordance with ASME/ANSI B1.20.1.

Table 2.1 Ductile Iron Pipe for Use with Threaded Flanges				
Nominal Pipe Size (in)	Maximum Working Pressure (psi)	Pipe Nominal Thickness* (in)	Pipe OD (in)	Maximum Nominal Length
3	250	0.31	3.96	19'-6"
4	250	0.32	4.80	19'-6"
6	250	0.34	6.90	19'-6"
8	250	0.36	9.05	19'-6"
10	250	0.38	11.10	19'-6"
12	250	0.40	13.20	19'-6"
14	250	0.42	15.30	19'-6"
16	250	0.43	17.40	19'-6"
18	250	0.44	19.50	19'-6"
20	250	0.45	21.60	19'-6"
24	250	0.47	25.80	19'-6"
30	250	0.51	32.00	19'-6"
36	250	0.58	38.30	19'-6"

3. Flanges shall be ductile-iron or gray-iron solid type with an internal taper pipe thread in accordance with ASME/ANSI B1.20.1. They shall be flat-faced with dimensions and bolthole patterns for a water service rating of 250 psi working pressure in accordance with ASME/ANSI B.16.1, Class 125 flanges. Flanges may be back- or spot-faced to conform with flange thickness tolerances. Hollowback flanges are not acceptable.

4. All flanged pipes shall meet the fabrication tolerances specified in ANSI/AWWA C151/A21.51 and shall be inspected, tested and so marked by the manufacturer.
5. Fittings shall be ductile iron or cast iron flanged joint in accordance with ANSI/AWWA C110/A21.10 with a minimum rating of 250 psi working pressure.
6. Nuts, bolts, and gaskets for flanged joints shall be provided by the. Gaskets shall be full face, minimum 1/8-inch thick synthetic rubber manufacturer adequate for the type of service and pressure rating of the joint with molded annular rings.

2.03 JOINT RESTRAINT FOR DUCTILE IRON PIPE

- A. Pipe joint restraint for standard mechanical joints shall be incorporated into the design of the follower gland and shall include a restraining mechanism which, when activated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Flexibility of the joint shall be maintained after burial. Glands shall be manufactured of ductile iron conforming to ASTM A536. Restraining devices shall be of ductile iron heat treated to minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with a standard mechanical joint bell and tee-head bolts conforming to ANSI A21.11 and ANSI/AWWA C153/A21.53. Twist-off nuts shall be used on the restraining devices to ensure proper actuating of the restraining devices. The mechanical joint restraint system shall be designed for a working pressure of 250 psi with a minimum factor of safety of 2. Restrained joint devices shall be Meg-a-Lug as manufactured by Ebba Iron or equal. Standard mechanical joint retainer glands are not acceptable.
- B. For 4" to 12" pipes, pipe joint restraint for push on joint pipe shall be American Standard Fastite joint with Fast-Grip gasket, American Flex-Ring joint or equal.
- C. Pipe joint restraint across flange adapters and couplings shall be by threaded rods as depicted on the Drawings. Threaded rods shall clear the periphery of adapter and coupling flanges and shall span across to the adjacent flange by flange joints. Gusset plates shall be provided as necessary and fabricated out of 3/4-inch thick ASTM A-36 steel plate, dimensions and number as required.

2.04 LININGS FOR DUCTILE IRON PIPE

- A. Ductile iron pipe and fittings for potable water mains, shall have standard thickness cement mortar lining and asphaltic material seal coat in accordance with ANSI/AWWA C104/A21.4.

2.05 COATINGS & FINISHES FOR DUCTILE IRON PIPE

- A. All buried or submerged ductile iron pipe and fittings shall receive an exterior asphaltic coating approximately 1 mil thick in accordance with ANSI/AWWA C151A/A21.51.
- B. All above grade pipe and fittings, exposed to view in the finished work or in non-submerged concrete pits or structures, shall not receive the asphaltic coating but shall be shop primed and field painted. The pipe shall be color coded, labeled as to type of service and marked for flow direction. Asphaltic coating on pipe penetrating the ground or inadvertently applied to

above grade pipe shall receive a non-bleeding sealer prior to being painted.

2.06 PVC PRESSURE PIPE 3-INCHES IN DIAMETER AND SMALLER

- A. Pipe shall have the following properties at 73°F
- | | | |
|----|--|---------------|
| 1. | Tensile Strength | 7,000 psi |
| 2. | Modules of Elasticity in Tension | 400,000 psi |
| 3. | Compressive Strength | 96,000 psi |
| 4. | Flexural Strength | 12,700 psi |
| 5. | Izod Impact Strength | 0.65 |
| 6. | Relative Hardness (Durometer/Rockwell) | 80± 3/110-120 |
| 7. | Cell Designation | 12454-B |
- B. Pipe shall be Schedule 80 PVC with solvent weld or threaded fittings meeting ASTM and NSF industry standards. Physical dimensions and tolerances shall be in accordance with ASTM D-1785 with the pipe appropriately marked.
- C. Schedule 80 solvent weld socket fittings shall be in accordance with ASTM D-2467. Solvent welding shall be in strict accordance with manufacturer's instructions with Schedule 80 solvent weld cement and related products only. Schedule 80 threaded fittings shall be in accordance with ASTM D-2464, all threaded connections shall be taped with teflon tape. All PVC to metal pipe connections shall be flanged. All PVC unions shall have O-rings seats.

2.07 PVC PRESSURE PIPE 4-INCHES IN DIAMETER AND LARGER

- A. Pipe shall have the following properties at 73 °F:
- | | | |
|----|----------------------------------|------------------|
| 1. | Tensile Strength | 7,000 psi |
| 2. | Modules of Elasticity in Tension | 400,000 psi |
| 3. | Izod Impact Strength | 0.65 |
| 4. | Cell Designation | 12454A or 12454B |
| 5. | Hydrostatic Design Basis(HDB) | 4,000 psi |
- B. Pipe shall be cast iron (CI) equivalent outside diameter with Elastomeric rubber gasket push-on joints in accordance with ASTM F477.
1. Pipe 4-inches through 12-inches in diameter shall be AWWA C900 DR 18, Pressure Class 150 psi rated at 73.4°F. Dimensions, tolerances, inspection, testing, and pipe marking shall be in accordance with AWWA C900, latest edition.
 2. Pipe greater than 12-inches in diameter shall be AWWA C905 DR25, Pressure Rating 165 psi at 73.4°F. Dimensions, tolerances, inspection, testing, and pipe markings shall be in accordance with AWWA C905, latest edition.
- C. Fittings shall be of ductile iron in accordance with paragraph 2.01 of this section.
- D. Pipe shall be supplied in lengths not exceeding a nominal 20 feet.

2.08 JOINT RESTRAINT FOR PVC PRESSURE PIPE 4-IN. THROUGH 12-IN.

- A. Where pipe restraint is required, it shall be provided by restraining sufficient length of pipe with mechanical type devices. Mechanical restraint devices for PVC pipe shall meet the following requirements.
1. Push-on joint pipe restraint: Mechanical devices shall be full circumferential contact compression type consisting of two rings connected across the pipe joint with restraining rods and associated hardware. The pipe bell ring shall be a single piece ductile iron retainer ring that slides over the pipe plain end up to the pipe bell. The pipe plain end ring shall be a two piece ductile iron restrainer with a serrated-face to contact the pipe. The restrainer shall be assembled on the pipe with side clamping bolts and nuts. The design tolerances to which the restrainer is machined will prevent over-tightening which could weaken or damage the pipe. Ductile iron rings shall be ASTM A536, Grade 65-45-12. Connecting bolts shall be in accordance with ANSI/AWWA C111/A21.11. The restraining devices shall be rated for a working pressure equivalent to the pressure rating of the pipe and shall meet or exceed the requirements of UNI-B-13-94, Recommended Performance Specification for Joint Restraint Devices for Use with PVC Pipe. The devices shall be Uni-Flange Block Buster Series 1350 or Owner approved equal.
 2. Mechanical Joint Fitting Restraint: Mechanical restraining devices shall have a full circumferential contact compression 2-piece split ring restrainer which is assembled on the PVC pipe with slide clamping bolts and nuts. The restrainer shall be designed to attach to Standard mechanical joints with extra long T-bolt studs in 4-inch through 12-inch sizes and with threaded restraining rods in 14-inch through 36-inch sizes. The device shall be of ductile iron ASTM A536, Grade 65-45-12. Connection bolts and hardware shall be in accordance with ANSI/AWWA C111/A21.11. The restraining devices shall be rated for a working pressure equivalent to the pressure rating of the pipe and shall meet or exceed the requirements of UNI-B-13-94, Recommended Performance Specification for Joint Restraint Devices for Use with PVC Pipe. The devices shall be Uni-Flange Block Buster Series 1300 or Owner approved equal.

2.09 GATE VALVES

- A. When full open, gate valves shall have a clear waterway equal to the nominal diameter of the pipe. Operating nut or wheel shall have an arrow cast in the metal indicating the direction of opening. Each valve shall have the manufacturer's distinctive marking, pressure rating and year of manufacture cast on the body. Prior to shipment from the factory, each valve shall be tested by applying it to a hydrostatic pressure equal to twice the specified working pressure. Exercise care in transporting and handling valves to avoid damage. Inside valves shall be kept free of dirt and debris. All gate valves shall have mechanical joint ends or flanged ends to fit the pipe run in which they are to be used. Gate valves shall open left or counter-clockwise when viewed from the stem. Buried gate valves shall be furnished with 2-inch square AWWA standard nut operators with a valve box and cover. Gate valves located above ground or inside structures shall be furnished with hand wheel operators and shall have a suitable indicator arrow to give valve position from fully open to fully closed. Unless

shown or specified otherwise, manually operated valves shall be equipped with a mechanism which will allow the valve to be opened or closed with a force of not more than 40 lb. applied to the nut, crank, or hand wheel. Hydrostatic and leakage tests shall be conducted in strict accordance with ANSI/AWWA C500, latest revision or ANSI/AWWA C509, latest revision, whichever is applicable.

- B. Double Disc Gate Valves 2 to 2 ½ Inch: Valves shall conform to ANSI/AWWA C500, latest revision and shall be designed for a minimum working pressure of 200 psi. Valves shall be iron body, bronze mounted, parallel seat, non-rising stem type with O-ring stem seals. Interior ferrous surfaces of valve, except for finished for wearing, shall be coated with a two-part thermosetting epoxy coating in accordance with AWWA C550, latest revision. Surfaces shall be clean, dry, and free from rust and grease before coating. Exterior surfaces of valve shall be coated as specified hereinafter. Gate valves for this size range shall be as manufactured by Mueller Company, M&H Valve Company or Owner approved equal.
- C. Resilient Seat Gate Valves 3 to 24 Inch: Resilient Seat Gate Valves shall be used on all potable water lines. Valves shall conform to ANSI/AWWA C509, latest revision and shall be designed for a minimum working pressure of 150 psi. Valves shall be iron body with non-rising stem and O-ring stem seals. The valve stem, stem nut, glands and bushings shall be bronze. Valve disc shall be constructed to assure uniform seating pressure between disc seating and body seating surface. Body seating surface shall be resilient seat ring seals made from internally reinforced molded rubber which are attached to the disc ring with stainless steel screws, or by a special corrosion resistant, synthetic elastomer which is permanently bonded to and completely encapsulates a cast iron valve disc. Interior of valve body and valve disc shall be coated with a two-part thermosetting epoxy-coating in accordance with AWWA C550, latest revision. Surfaces shall be clean, dry and free from rust and grease before coating. Exterior surfaces of valve shall be coated as specified hereinafter. Gate valves for this size range shall be as manufactured by Mueller Company, American-Darling Company, US. Pipe, Kennedy Valve Company, or approved equal.

2.10 CHECK VALVES

- A. Check valves for potable water service shall be cast iron bodied per AWWA C508, latest revision, with integral ANSI Class 125 flanges. Valves shall have a field replaceable centrifugally cast bronze body seat located in place with stainless steel screws. The valve shaft shall be a one-piece shaft of Type 17-4PH steel, which shall extend through both sides of the valve body. An outside lever and weight shall be attached to one side of the shaft; an oil filled control dampening device shall be attached to the other side of the shaft. The valve disc shall be of ASTM A126 Grade B cast iron and the disc seat shall be of BUNA-N. The control device shall consist of a side-mounted, oil-filled cylinder, which provides (3) closing speed stages. All control stages shall be fully adjustable. Check valves shall be GA Industries, Flomatic, Apco Series 6100, or an approved equal.

2.11 VALVE BOXES

- A. All buried valves shall have cast iron three-piece valve boxes. Valve boxes shall be provided with suitable heavy bonnets and extend to such elevation at or slightly above the finished grade surface as directed by the Owner. The barrel shall have two-piece, sliding type, having 5-1/4- inch shaft. The upper section shall have a flange at the bottom having sufficient bearing area to prevent settling and shall be complete with cast iron covers. Covers shall

have "WATER" cast into the top as applicable to service. All valves shall have actuating nuts extended to top of valve boxes. Valve boxes shall be provided with concrete base and valve nameplate engraved with lettering 1/8-inch deep as shown on the Drawings.

2.12 FLEXIBLE COUPLINGS

- A. Flexible couplings shall be of the sleeve type as shown on the Drawings and as follows:
1. Sleeve type couplings shall be used with all buried piping and where shown on the Drawings. The couplings shall be of steel and shall be Dresser Style 38, Rockwell Model 413, Baker Allsteel, or equal. The couplings shall be provided with hot dipped galvanized steel bolts and nuts unless indicated otherwise.
 2. Flanged adapters shall be Dresser Type 128, Rockwell Model 913, or equal.
 3. All couplings shall be furnished with the pipe stop removed.
 4. Couplings shall be provided with gaskets of a composition suitable for contact with potable water.

2.13 HARNESSING SYSTEMS

- A. All expansion joints specified in Paragraph 2.06 and flexible couplings specified in Paragraph 2.07 shall be restrained with threaded tie rods and lugs. Tie rods shall be threaded rods manufactured of ASTM A36 steel and shall be hot dip galvanized. All bolts and washers shall be hot dip galvanized. Lugs for tie rods shall connect to flange bolts and provide a device, which allows installation of tie rods outside the periphery of the pipe flanges. Lugs shall be manufactured of ASTM A36 steel, ASTM A283 Grade B, C, or D steel, or ASTM A255 Grade C steel. Lug dimensions shall conform to AWWA Manual M11, Table 19.7. Washers shall be provided for all lugs; washers shall have a minimum thickness of 1/8 inch. Tie rods for restraint of the above coupling and joints shall be furnished as shown below.

<u>PIPE SIZE</u>	<u>NUMBER OF TIE RODS</u>	<u>ROD SIZE (INCHES)</u>
3	4	5/8
4	4	5/8
6	4	3/4
8	4	3/4
10	4	7/8
12	4	7/8

2.14 PRESSURE GAUGES

- A. Each pressure gauge shall be a flange-mounted water sensor conforming to ANSI 125-lb. flange drilling specifications. Pressure sensor shall provide a full 360-degree circumferential reading of line fluids, while isolating them from the gauge with a flexible rubber sleeve. Line pressure shall be transferred from the flexible rubber sleeve to the gauge through a captive fluid with a maximum error rate of 2%. Captive sensing fluid shall be ethylene glycol/glycerin. An alternate pressure sensor shall be diaphragm seals with a ball valve for easy removal of pressure gauge.

- B. Water body and end flanges shall be carbon steel. All wetted steel parts of the sensor shall be Teflon coated. Sleeve material shall be BUNA N.
- C. Gauge shall have a 4" minimum diameter. Pressure gauge shall have an operating range of 0 – 100 psig or as indicated in specification or drawings.
- D. Pressure gauges shall be Series 40, in-line water sensor, as manufactured by Red Valve, Carnegie, Pennsylvania, Wika, or an approved equal. Diaphragm seals shall be manufactured by HYET Instrument Co., Bridge City, Texas.

2.15 BALL VALVES

- A. Ball valves for copper, black steel, and galvanized steel pipe and for below grade PVC pipe shall be Type 1000 as manufactured by Jamesbury, American Valve Milano Series figure M200, Crane Figure 9303-B, or Owner approved equal. Ball valves shall have threaded ends, bronze body, TFE seats and seals and ¼ turn to open lever handles. Below grade service ball valves shall be supplied with and installed in precast concrete access boxes.

2.16 TAPPING SADDLES FOR PVC WATER MAINS

- A. Tapping saddles shall be double-strap type saddles suitable for wet-tapping water mains. Each saddle shall be rated for a 200 psi working pressure and shall have a threaded outlet compatible with the tapping valve and other appurtenances furnished. Tapping saddles shall have epoxy coated steel bodies and stainless steel straps and hardware. Tapping saddles shall be Smith-Blair Model 313, Ford Model F-202, JCM Model 402, Mueller Series 10500, Baker Shur Seal-O or an approved equal.

2.17 CORPORATION STOPS

- A. Corporation stops for connections to cast-iron, ductile iron or steel piping shall be Ford Model F-1000 or FB-1000, McDonald Model 4701-T, Mueller Model H-15008 or H-15013, Hays Model 5200 DF or 4400 DF or an approved equal.

2.18 BACKFLOW PREVENTERS

- A. Backflow preventers shall be reduced pressure type backflow preventers meeting all applicable AWWA requirements and the Owner's code requirement. Backflow preventers shall be manufactured by Febco, Watts, Zurn/Wilkins or an approved equal.
- B. Backflow Preventers from 2 ½" through 10" shall meet all applicable requirements of AWWA C511 and the USC manual for Cross Connection Control. They shall have fused epoxy coated cast iron bodies, replaceable bronze seats, and OSY resilient seated gate valves. Maximum pressure drop across an 8-inch valve at 1250 gpm shall not exceed 11 ½ psi.
- C. Backflow preventers from ¾" through 2" shall meet all applicable requirements of AWWA C506 and the USC Manual for Cross Connection Control. They shall have threaded end bronze bodies with a rated working pressure of 175 psi. Valves must be supplied with resilient seated ball valve shut-offs and test cocks. Maximum pressure drop across a 1-inch

valve at 30 gpm shall not exceed 11 psi.

2.19 DRY BARREL FIRE HYDRANT

- A. Fire hydrants shall be Traffic Dry Barrel Type and shall meet or exceed all applicable requirements and tests of ANSI and the latest revisions of AWWA Standard C502. Fire hydrants shall meet all test requirements and shall be listed by Underwriters Laboratories Inc. Fire Hydrants shall be rated for a working pressure of 250 PSIG. (1725 kPa). Manufacturers shall provide sufficient documentation to assure that their hydrant will successfully meet section 24.1 of UL 246 Standard.
1. Fire hydrant shall be of ample length for 3' – 6" depth of bury with a 4 foot square by 8-inch thick concrete thrust collar at 14-inches below finish grade.
 2. Fire hydrants shall be of the true compression type, opening against the pressure and closing with the pressure. Fire hydrants shall have a 5-1/4" main valve opening, and have a minimum inside barrel diameter of 7 inches to assure maximum flow.
 3. Fire hydrants shall be three-way in design, having one 4-1/2" NST pumper nozzle and two 2-1/2" NST hose nozzles. Nozzles shall thread counter-clockwise into the hydrant barrel utilizing O-ring pressure seals. A suitable nozzle lock shall be in place to prevent inadvertent nozzle removal.
 4. The bonnet assembly shall provide an oil reservoir and lubrication system that automatically circulates to all stem threads and bearing surfaces each time the hydrant is operated. This lubrication system shall be sealed from the waterway and any external contaminants by use of O-ring pressure seals. An anti-friction washer shall be in place above the thrust collar to further minimize operating torque. The oil reservoir shall be factory filled with a low viscosity, FDA approved non-toxic oil lubricant which will remain fluid through a temperature range of -60 degrees F. to +150 degrees F.
 5. The operating nut shall be a one-piece design, manufactured of ASTM B-584 bronze. It shall be pentagon in shape, measuring 1-1/2" from point to flat. The operating nut shall be affixed to the bonnet by means of an ASTM B-584 bronze hold down nut. The hold down nut shall be threaded into the bonnet in such a manner as to prevent accidental disengagement during the opening cycle of the hydrant. The use of Allen head set screws as a means of retention is unacceptable. A resilient weather seal shall be incorporated into the hold down nut, for the purpose of protecting the operating mechanism from the elements.
 6. The direction of the opening shall be left. An arrow shall be cast on the bonnet flange to indicate the operating direction.
 7. The hydrant bonnet shall be attached to the upper barrel by not less than eight bolts and nuts, and sealed by means of the O-ring pressure seal.
 8. Hydrants shall be "traffic-model" having upper and lower barrels joined at the groundline by a separate and breakable "swivel" flange providing 360 rotation of upper barrel for proper nozzle facing. This flange shall employ not less than eight bolts. The pressure seal between the barrels shall be an O-ring. The proper

groundline shall be cast clearly on the lower barrel and shall provide not less than 18" of clearance from the centerline of the lowest nozzle to the ground.

9. The operating stem shall be two pieces, not less than 1-1/4" diameter (excluding threaded or machined areas) and shall be connected by a torque diverting stem coupling near the groundline flange which shall be manufactured of stainless steel to minimize galvanic action at this point. Screws, pins, or fasteners used in conjunction with the stem coupling shall also be stainless steel. The top of the lower stem shall be recessed 2" below the face of the safety flange to prevent water hammer in the event of a "drive over" where a vehicle tire might accidentally depress the main valve.
10. Hydrant shoe and barrel castings shall be cast of ASTM A-126, class B gray iron or ductile iron ASTM A-536, but no combination thereof, assuring uniform strength of all cast components and minimizing the possibility of shoe breakage upon traffic impact. The lower barrel shall be an integrally cast unit. The use of threaded on or mechanically attached flanges is deemed unacceptable. The inside diameter of the hydrant barrels shall not be less than seven inches (7").
11. Main valves shall be "compression type", closing with the pressure and shall not be less than 5-1/4" in diameter. Composition of the main valve shall be a molded rubber having a durometer hardness of 95+/-5 and shall be reversible in design. The main valve shall not be less than 1" thick.
12. Hydrants shall be equipped with (2) two drain valves which drain the barrel when the hydrant is closed and seal shut when the hydrant is opened. These drain valves shall be an integral part of the one piece bronze upper valve plate. They shall operate without the use of springs, toggles, tubes, levers or other intricate synchronizing mechanisms.
13. The upper valve plate, seat ring and drain ring (shoe bushing) must be ASTM B-584 bronze and work in conjunction to form an all bronze drainway. A minimum of two (2) internal and two (2) external drain openings are required. Drains ported through the cast iron shoe must be bronze lined.
14. The bronze seat ring shall thread into a bronze drain ring (or shoe bushing) providing a bronze-to-bronze connection. Seat rings shall be O-ring pressure sealed.
15. The 6" shoe connection shall be as specified (flanged, A/C, M.J., etc.) having ample blocking pads for sturdy setting and two strapping lugs to secure the hydrant to piping. A minimum of six bolts and nuts is required to fasten the shoe to the lower barrel.
16. The interior of the shoe including the lower valve plate and stem cap nut shall have a protective coating of a two part thermosetting epoxy to a minimum thickness of 4 mils. If a stem cap nut is utilized, it must be locked in place by a stainless steel lock washer or similar non-corrosive device.
17. Hydrants shall be warranted by the manufacturer against defects in materials or workmanship for a period of ten (10) years from the date of manufacture.

18. Hydrants shall be Mueller Super Centurion 250 or approved equal.
- B. Existing fire hydrants to be relocated shall be thoroughly reconditioned to a serviceable condition satisfactory to the Engineer and the Owner. The outside of the hydrant above the finished ground line shall be thoroughly cleaned and thereafter painted with one coat of paint of a durable composition plus one additional coat of finish paint.
- C. Fire hydrant assemblies including all pipe, fittings, valves and appurtenances shall have restrained joints from the hydrant to the limits shown on the drawings.

PART 3 - EXECUTION

3.01 DELIVERY, STORAGE AND HANDLING OF DUCTILE IRON PIPE & FITTINGS

- A. Delivery and Storage: Delivery and storage of the materials shall be in accordance with manufacturer recommendations and ANSI/AWWA C600.B.
- B. Handling: Care shall be taken in loading, transporting and unloading to prevent damage to the pipe or fittings and their respective linings and coatings. Pipe or fittings shall not be rolled off the carrier or dropped. Unloading shall be done by lifting with a forklift or crane. All pipe or fittings shall be examined before laying, and no piece shall be installed which is found to be defective.
- C. If any defective pipe is discovered after it has been laid it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional expense to the Owner. All pipe and fittings shall be thoroughly cleaned before laying, shall be kept clean until they are used in the work, and when installed or laid, shall conform to the lines and grades required.

3.02 INSTALLATION (DUCTILE IRON PIPE AND FITTINGS)

- A. Below grade ductile iron pipe and fittings shall be installed in accordance with requirements of ANSI/AWWA C-600 and manufacturer recommendations. Pipes shall be laid to the lines and grades shown on the Drawings with a minimum of 3 feet of cover from proposed finished grades. Pipes shall be laid at a constant slope between elevations specified. Pipe joints may be deflected to a maximum of 75% of manufacturer recommendations to establish alignment, slope, and grade.
- B. Above grade flanged ductile iron pipe and fittings shall be installed true to alignment and adequately supported. All valves, fittings, equipment, and appurtenances needed upon the pipelines shall be set and jointed as indicated on the Drawings or as required. All pipe and appurtenances connected to equipment shall be supported in such manner as to prevent any strain being imposed on the equipment. Supports shall be provided at each fitting/valve/appurtenance or combination thereof and at a maximum spacing of 6 feet.
- C. All field cutting of pipe shall be performed in accordance with the requirements of ANSI/AWWA C600 and manufacturer recommendations. Field touch-up of linings shall be per manufacturer recommendations.

3.03 DELIVERY, STORAGE, AND HANDLING OF PVC PIPE

- A. Delivery and Storage: Delivery and storage of the materials shall be in accordance with manufacturer recommendations and ANSI/AWWA C605.
- B. Handling: Care shall be taken in loading, transporting and unloading to prevent damage to the pipe. Pipe shall not be rolled off the carrier or dropped. Unloading shall be done by lifting with a forklift or crane. All pipe or fittings shall be examined before laying, and no piece shall be installed which is found to be defective.
- C. If any defective pipe is discovered after it has been laid it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional expense to the Owner. All pipe and fittings shall be thoroughly cleaned before laying, shall be kept clean until they are used in the work, and when installed or laid, shall conform to the lines and grades required.

3.04 INSTALLATION (PVC PIPE)

- A. Below grade PVC pipe shall be installed in accordance with requirements of ANSI/ AWWA C605, manufacturer recommendations and ASTM D2321. Pipes shall be laid to the lines and grades shown on the drawings with a minimum of 3 feet of cover from proposed finished grades. Pipes shall be laid at a constant slope between elevations specified. Pipe joints may be deflected to a maximum of 75% of manufacturer recommendations to establish alignment, slope, and grade.
- B. All field cutting of pipe shall be performed in accordance with the requirements of ANSI/AWWA C605 and manufacturer's recommendations. Installation of valves and fittings shall be strictly in accordance with manufacturer's instructions. Particular care shall be taken not to over-stress threaded connections. Except for ductile iron mechanical joint fittings, all plastic pipe to metal pipe connections shall be made using flanged connections. Metal piping shall not be threaded into plastic fittings, valves, or couplings, nor shall plastic piping be threaded into metal valves, fittings, or couplings.

3.05 INSTALLATION OF VALVES AND APPURTENANCES

- A. All valves and appurtenances shall be installed in the locations shown, true to alignment and rigidly supported. Any damage to the above items shall be repaired to the satisfaction of the Owner before they are installed.
- B. Pipe for use with flexible couplings shall have plain ends.
- C. Prior to the installation of sleeve-type couplings, the pipe ends shall be cleaned thoroughly for a distance of 8 inches. Soapy water may be used as a gasket lubricant. A follower and gasket, in that order, shall be slipped over each pipe to a distance of about 6 inches from the end, and the middle ring shall be placed on the already laid pipe end until it is properly centered over the joint. The other pipe end shall be inserted into the middle ring and brought to proper position in relation to the pipe already laid. The gaskets and followers shall then be pressed evenly and firmly into the middle ring flares. After the bolts have been inserted and all nuts have been made up finger-tight diametrically opposite nuts shall be progressively and uniformly tightened all around the joint by use of a torque wrench of the appropriate size and torque for the bolts.

- D. Pressure gauges shall not be installed until after the substantial completion date unless otherwise requested by the Owner.
- E. Valve boxes with concrete bases shall be installed as shown on the drawings. Mechanical joints shall be made in the standard manner. Valve stems shall be vertical in all cases. Place cast iron box over each stem with base bearing on compacted fill or bedding rock and the top shall be set flush with final grade. Boxes shall have sufficient bracing to maintain alignment during backfilling. Knobs on cover shall be parallel to pipe. Remove any sand or undesirable fill from valve box.

3.06 BEDDING AND BACKFILLING

- A. Pipe bedding and backfilling shall be in accordance with the requirements in the plans.
- B. Bedding: Bedding material shall consist of pearock, drainfield limerock or similar material approved by the Engineer in wet trenches, and limerock screenings, sand or other fine inorganic material approved by the Engineer in dry trenches.

After pipe trenches have been excavated to the proper depths, backfill the resulting excavation with approved pipe bedding material, up to the level of the lower one-third of the proposed pipe barrel. Tamp, compact and shape this material to provide a proper bedding for the pipe. Provide bedding under the branch of all fittings to furnish adequate support and bearing under the fitting.

Backfill any excess excavation below the levels required for installation of the pipe bedding, with approved bedding material, tamped, compacted and shaped to provide proper support for the proposed pipe.

- C. Backfill Material: Suitable fill material as specified elsewhere in the contract documents shall contain no stones or rocks larger than 6-inches in diameter, and, when placed within 1-foot of piping and appurtenances, shall contain no stones or rocks larger than 2-inches in diameter (1-inch for PVC pipe).

Backfilling of utility trenches will not be allowed until installation of pipe and appurtenances has been approved and pressure tested if required. Uncover or expose for inspection at no cost to the Owner any work which is covered or concealed without the knowledge and consent of the Engineer. Partial backfill may be placed to restrain the pipe during pressure testing.

If a sufficient quantity of suitable backfill material is not available from the trench or other excavations within the site of the work, provide and install additional material suitable for this purpose.

Place backfill material in 6-inch layers and compact per the densities specified in the embankment specification, but not less than 90% of the maximum density of the material. After the backfill has been placed to a level 12-inches over the pipe, place the remainder of the backfill in layers not to exceed 9-inches, and compact with mechanical vibrators or other suitable equipment to obtain a density of the backfilled material as specified in the embankment specification. Exercise particular attention and care in obtaining thorough

support for the branch of all service connection fittings and to preserve the alignment and gradient of the installed pipe.

Within paved areas of trench excavation, reconstruct the base and surfacing as specified under the appropriate specification section. Partially backfill no more than 800-feet of trench with pipe in place at any time unless otherwise approved by the Engineer.

3.07 CLEANING.

At the conclusion of the work, the Contractor shall thoroughly clean the new pipe lines by flushing with water or other means to remove all dirt, stones or other material which may have entered the line during the construction period. The Contractor shall pay for and provide all water, pumps, piping, and related equipment required for cleaning at no additional cost to the owner.

Flushing will be accomplished using a temporary jumper connection.

3.08 HYDROSTATIC PRESSURE AND LEAKAGE TESTING

- A. Hydrostatic tests shall consist of a pressure test and a leakage test. Hydrostatic tests shall be conducted on all newly laid pressure pipes, joints, and valves including all service lines. Air testing of pressure pipes will not be permitted under any circumstance. Tests shall be made on sections not exceeding 2,000 ft. The Contractor shall furnish all closure pieces in the pipe as required. Equipment to be furnished by the Contractor shall include, but not be limited to, graduated containers, pressure gauges, hydraulic force pumps, suitable hoses and piping, and temporary jumper connection with reduced pressure backflow prevention device as shown on the Drawings. The Owner will monitor and approve a satisfactory test. The Contractor shall pay for, provide, and dispose of all flushing and test water at no additional cost to the Owner.
- B. The Contractor may conduct hydrostatic tests after the trench has been partially backfilled with the joints left exposed for inspection for his informational purposes only. The hydrostatic tests for acceptance shall only be conducted after the trenches have been completely backfilled and compacted as specified. Where any section of pipe is provided with concrete thrust blocking, tests will not be made until at least five (5) days have elapsed after the thrust blocking is installed. If high early strength cement is used for the concrete thrust blocking, the time may be reduced to 24 hours.
- C. All pressure pipe sections to be tested shall be subjected to hydrostatic pressure and leakage tests. Test pressures for potable water mains shall be 150 psi.
- D. The duration of pressure and leakage tests shall be for periods of 2 hours each. If during the tests, the integrity of the tested line is in question, the Owner may require 6-hour tests. The basic provisions of AWWA C-600 shall be applicable.
- E. Pressure Test:

Each section of pipe to be tested, as determined by the Owner, shall be slowly filled with water and the specified test pressure shall be applied by means of a pump connected to the pipe in a satisfactory manner. Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, and appropriate valves installed to ensure bleeding of all air from the main. If defective pipes, fittings, valves, or

hydrants are discovered in consequence of the pressure test, all such items shall be removed and replaced by the Contractor with sound material and tests shall be repeated until satisfactory results are obtained. Provisions of AWWA C-600, where applicable, shall apply.

F. Leakage Test:

1. After completion of the pressure test, a leakage test shall be conducted to determine the quantity of water lost by leakage under the specified test pressure. Applicable provisions of AWWA C-600 shall apply.
2. Allowable leakage in gallons per hour for the pipeline shall not be greater than that determined by the formula:

$$L = \frac{SD(P)^{0.5}}{133,200}$$

- where:
- L = Allowable leakage in gallons per hour.
 - S = Length of pipe tested, in feet.
 - D = Nominal diameter of pipe in inches.
 - P = Average test pressure during leakage test in pounds per square inch gauge.

3. Leakage is defined as the quantity of water to be supplied in the newly laid pipe or any valved section under test, which is necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled. Should any test of pipe laid disclose leakage greater than that allowed, the Contractor shall locate and replace or repair the defective joints, pipe or valves until the leakage from subsequent testing is within the specified allowance.

3.09 DISINFECTION OF WATER MAINS

- A. Before being placed in service, all new water mains shall be chlorinated in accordance in the specifications below and the procedures outlined in ANSI/AWWA C-651 Disinfecting Water Mains. A temporary jumper connection shall be provided by the Contractor as shown on the Drawings.
- B. Sections of pipe to be disinfected shall first be flushed (*full diameter) to remove any solids or contaminated material that may have become lodged in the pipe. If no hydrant is installed at the end of the main, then a blow-off valve shall be provided large enough to develop a velocity of at least 2.5 feet per second in the main. The Contractor shall pay for all flushing and disinfecting water at no additional cost to the Owner.
- C. All taps required for chlorination or flushing purposes, or for temporary or permanent release of air shall be provided for by the Contractor as a part of the construction of water mains. After the disinfection, all such taps shall be sealed to the satisfaction of the Owner.
- D. Before being placed into service, all new mains and repaired portions of, or extensions to existing mains shall be chlorinated so that the initial chlorine residual is not less than 50 mg/l and that a chlorine residual of not less than 25 mg/l remains in the water after standing 24

hours in the pipe.

- E. Chlorine may be applied as a liquid chlorine (gas-water mixture), or a mixture of water and high-test calcium hypochlorite. The Contractor shall assume responsibility for safe handling of chlorine and shall meet requirements of OSHA and other regulatory agencies for safe handling of chlorine.
- F. The preferred point of application of the chlorinating agent is at the beginning of the pipeline extension or any valved section of it, and through a corporation stop inserted in the pipe. The water injector for delivering the chlorine-bearing water into the pipe should be supplied from a tap made on the pressure side of the gate valve controlling the flow into the pipe line extension.
- G. Valves shall be manipulated by the Owner's personnel so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water.
- H. Treated water shall be retained in the pipe at least 24 hours. After this period, the chlorine residual at pipe extremities and at other representative points shall be at least 25 mg/l.
- I. In the process of chlorinating newly laid pipe, all valves or other appurtenances shall be operable while the pipe line is filled with the chlorinating agent and under normal operating pressure.
- J. Following chlorination, all treated water shall be thoroughly flushed from the newly laid pipe at its extremity until the replacement water throughout its length shows upon test, a free chlorine residual not in excess of that normally carried in the system.
- K. After flushing, water samples collected on 2 successive days from the treated piping system, as directed by the Owner, shall show acceptable bacteriological results. All bacteriological sampling and testing shall be provided by the Contractor. All such bacteriological analyses must be performed by a laboratory certified by the State of Florida.
- L. Proper chain of custody procedures must be followed and samples shall only be collected by certified laboratory personnel in the presence of the Owner's personnel.
- M. Copies of testing results and all related correspondence with the Florida Department of Environmental Protection (FDEP) shall be submitted to the Owner.
- N. Should the initial treatment result in an unsatisfactory bacterial test, the original chlorination procedure shall be repeated by the Contractor until satisfactory results are obtained.

3.10 CORRECTION OF NON-CONFORMING WORK.

All non-conforming work shall be repaired or replaced by the Contractor at no additional expense to the Owner. Non-conforming work shall be defined as failure to adhere to any specific or implied directive of these specifications and/or the Drawings, including but not limited to pipe not laid straight, true to the lines and grades as shown on the drawings, damaged or unacceptable materials, excessive misalignment or diameter ring deflection in pipe due to bedding, backfilling or installation, visible or detectable leakage and failure to pass any specified test or inspection.

4.0 METHOD OF MEASUREMENT.

The length of waterline to be paid for shall be the number of linear feet of waterline in place, completed, and approved. It shall be measured along the centerline of the pipe from end to end and shall include bends, line stops, wet taps, jumper connections with RPZ backflow preventers, blow-off assemblies, and plugs. Fittings (other than those previously listed) shall be paid for separately under the respective contract unit price for which they are a part; however, price does include all materials, preparation, excavation, installation, labor, equipment, tools, supplies and incidentals to complete this work.

Waterline valves, fire hydrants, and other fittings shall be measured by each unit in place, completed, and approved.

5.0 BASIS OF PAYMENT.

Payment shall be made at the contract unit price per linear foot for waterline. This price shall be full compensation to the Contractor for furnishing all materials, preparation, excavation, installation, labor, equipment, tools, supplies and incidentals to complete this work.

The accepted quantities of tees, gate valves (with box), and fire hydrant assemblies will be paid for at the contract unit price per each, complete and in place. Bends, line stops, wet taps, jumper connections with RPZ backflow preventers, blow-off assemblies, and plugs shall be incidental to the associated waterline installation. This price shall be full compensation to the Contractor for furnishing all materials and for preparation, excavation, installation and backfilling of these materials; furnishing and installation of such specials and connections to pipes and other structures as may be required to complete the items as shown in the plans; and for all labor, equipment, tools, supplies, and incidentals to complete this work.

Payment shall be made under:

Item 02660-1	Potable Water Infrastructure – Lump Sum (LS)
Item 02660-2	Concrete Encased 6” Dip Water Line – Linear Feet (LF)

END OF SECTION 02660

**SECTION 02730
SANITARY SEWAGE SYSTEM**

PART 1 GENERAL

1.1 SCOPE OF WORK.

- A. This item consists of the furnishing of all labor, materials, equipment and incidentals required for the installation of construction at the locations depicted on the Drawings, or as required by the Contract Documents, all Piping, Fittings, Structures and appurtenances.
- B. The work generally includes designated on-site force mains, sanitary gravity mains, and services, manholes, appurtenances and other miscellaneous work as depicted on the Drawings or specified herein.
- C. General Design. The equipment and materials specified herein is intended to be standard types of pipe, fittings and appurtenances for use in transporting water and wastewater.

1.2 RELATED REQUIREMENTS

- A. P-152 Excavation and Embankment
- B. Section 02660 Water Distribution System
- C. Section 02221 Trenching and Backfilling for Utility Systems
- D. FDOT Section 400 Concrete Structures
- E. FDOT Section 425 Pre-Cast Concrete Structures

1.3 QUALITY ASSURANCE.

- A. The below listed standards are applicable and are adopted by reference:
 - 1. ANSI/AWWA C110/A21.10 Ductile Iron and Gray Iron Fittings 3 in through 48 inch for Water and other liquids.
 - 2. ANSI/AWWA C111/A21.11 Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.
 - 3. ANSI/AWWA C115/A21.15 Flanged Ductile-Iron Pipe with Threaded Flanges.
 - 4. ANSI/AWWA C150/A21.50 Thickness Design of Ductile-Iron Pipe.
 - 5. ANSI/AWWA C151/A21.51 Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds for Water or Other Liquids.
 - 6. ANSI/AWWA C153/A21.53 Ductile-Iron Compact Fittings, 3 in. Through 16 in., for Water and Other Liquids.
 - 7. ANSI/AWWA C508 Swing Check Values for Water Works Service-2 in through 24 in.
 - 8. ANSI/AWWA C600 Installation of Ductile-Iron Water Mains and Their Appurtenances.
 - 9. ANSI/AWWA C605 Underground Installation of Poly Vinyl Chloride (PVC) Pressure Pipe and Fittings for Water.

10. ANSI/AWWA C651 Disinfecting Water Mains
 11. ANSI/AWWA C900 Poly Vinyl Chloride (PVC) Pressure Pipe, 4-in through 12-in., for Water (ANSI/AWWA C900)
 12. ANSI/AWWA C905 Poly Vinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14-in. through 36-in.
 13. ASTM D1598 *Time-to-Failure of Plastic Pipe Under Constant Internal Pressure
 14. ASTM D1599 *Short-Time Rupture Strength of Plastic Pipe, Tubing and Fittings
 15. ASTM D1784 *Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride)(CPVC) Compounds
 16. ASTM D1785 *Poly (Vinyl Chloride)(CPVC) Compounds
 17. ASTM D2241 *Poly (Vinyl Chloride)(PVC) Plastic Pipe, Schedule 40, 80, and 120
 18. ASTM D2321 *Underground Installation of Flexible Thermoplastic Sewer Pipe
 19. ASTM D2412 *External Loading Properties of Plastic Pipe Parallel-Plate Loading
 20. ASTM D2444 *Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)
 21. ASTM D2466 *Poly (Vinyl Chloride)(PVC) Plastic Pipe Fittings, Schedule 40
 22. ASTM D2467 *Socket-Type Poly (Vinyl Chloride)(PVC) Plastic Pipe Fittings Schedule 80
 23. ASTM D2564 *Solvent Cements for Poly (Vinyl Chloride)(PVC) Plastic Pipe and Fittings
 24. ASTM D2774 *Underground Installation of Thermoplastic Pressure Piping
 25. ASTM D2855 *Making Solvent-Cemented Joints with Poly (Vinyl Chloride)(PVC) Pipe and Fittings
 26. ASTM D3034 *Type PSM Poly (Vinyl Chloride)(PVC) Sewer Pipe and Fittings
 27. ASTM D3139 *Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
 28. ASTM D3212 *Joints for Drain and Sewer Plastic Pipe Using Flexible Elastomeric Seals
 29. ASTM F477 *Elastomeric Seals (Gaskets) for Joining Plastic Pipe
 30. UNI-B-6 For Low-Pressure Air Testing of Installed Sewer Pipe
- B. Qualifications: All of the pipe, fittings and appurtenances shall be furnished by manufacturers who are fully experienced, reputable, and qualified in the manufacture of the materials to be furnished. The pipe, fittings and appurtenances shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with the adopted references and these specifications as applicable.
- C. Manufacturers of Ductile Iron Pipe and Fitting will be the American Cast Iron Pipe

Company, U.S. Pipe and Foundry Company, McWane Cast Iron Pipe Company or Owner approved equal.

- D. Factory Tests for D.I.P. and D.I. Fittings: The manufacturer shall perform the factory tests described in ANSI/AWWA C151/A-21.51 and shall submit sworn certifications of the factory tests and their results.
- E. PVC pipe shall be manufactured by Certain Teed, Diamond Plastics, Elson, J-M Pipe, North American Pipe Corp., or equal.
- F. PVC compounds shall be Class 12454A or 12454B in accordance with ASTM D1784. The manufacturer(s) of pipe supplied for this project shall provide a compliance statement for this and for all other qualifications required by this specification as applicable.
 - 1. Cell Classification Tests (ASTM D1784)
 - 2. Hydrostatic Design Stress Testing (ASTM D2837)
 - 3. Quick Burst Testing (ASTM D1599)
 - 4. Pipe Impact Testing (ASTM D2444)
 - 5. Pipe Stiffness Testing and Flattening Testing (ASTM D2412)
 - 6. Sustained Pressure Testing (ASTM D1598 & ASTM D2241)
 - 7. Hydrostatic Proof Testing (ANSI/AWWA C900)
- G. Quality Control
 - 1. The manufacturer shall establish the necessary quality control and inspection practice to ensure compliance with the referenced standards and shall provide written warranty for their products.

1.4 SUBMITTALS

- A. Within seven (7) days after execution of the Contract, submit a list of materials, names of manufacturers and dates of delivery of materials to the project site.
- B. Shop and Layout Drawings
 - 1. Submit complete shop drawings detailing all of the technical and dimensional data of material to be furnished including weights.
 - 2. Submit layout drawings including restrained joint layouts, fitting and joint layouts, and mechanical piping layouts with support locations. Layout drawings shall be prepared to an appropriate scale with dimensioning.
- B. Submit Manufacturer Certifications as required by these specifications.
- C. Submit Florida Licensed Surveyor Certified As-built drawings of force mains and piping with verified vertical and horizontal data as required by these specifications.
- D. Submit documentation for all tests required by these specifications.

1.5 PERMITS

- A. Contractor shall comply with all conditions of Florida Department of Environmental Protection (FDEP) wastewater permit.
- B. Contractor shall maintain copies of permits on-site and available all times for inspection by regulatory agencies throughout the course of the work.

1.6 JOB CONDITIONS

- A. **Water in Excavation.** Water shall not be allowed in the trenches while the pipes are being laid and/or tested. The Contractor shall not open more trench than the available plumbing facilities are able to dewater to the satisfaction of the Owner. The Contractor shall assume responsibility for disposing of all water so as not to injure or interfere with the normal drainage of the territory in which he is working. In no case shall the pipelines being installed be used as drains for such water, and the ends of the pipe shall be kept properly and adequately blocked during construction by the use of approved stoppers and not by improvised equipment. All necessary precautions shall be taken to prevent the entrance of mud, sand or other obstructing matter into the pipelines. If on completion of the work any such materials have entered the pipelines, it must be cleared as directed by the owner so that the entire system will be left clean and unobstructed.

PART 2 PRODUCTS

2.1 MANHOLES AND INSPECTION HOLES

- A. The brick shall conform to the requirements of ASTM C 32, Grade SM.
- B. Mortar shall consist of one part portland cement and two parts sand. The portland cement shall conform to the requirements of ASTM C 150, Type I. The sand shall conform to the requirements of ASTM C 144.
- C. Mortar shall consist of one part portland cement and two parts sand. The portland cement shall conform to the requirements of ASTM C 150, Type I. The sand shall conform to the requirements of ASTM C 144.
- D. Plain and reinforced concrete used in structures, connections of pipes with structures, and the support of structures or frames shall conform to the requirements of specification P-610 Structural Portland Cement Concrete and Section 03410.
- E. Precast concrete pipe manhole rings shall conform to the requirements of ASTM C 478. Unless otherwise specified, the risers and offset cone sections shall have an inside diameter of not less than 36 inches (90 cm) nor more than 48 inches (120 cm).
- F. Corrugated metal shall conform to the requirements of AASHTO M 36.
- G. Frames, covers, and grates. The castings shall conform to one of the following requirements:
 - 1. Gray iron castings shall meet the requirements of ASTM A 48, Class 30B and 35B.

2. Malleable iron castings shall meet the requirements of ASTM A 47.
3. Steel castings shall meet the requirements of ASTM A 27.
4. Structural steel for grates and frames shall conform to the requirements of ASTM A 283, Grade D.
5. Ductile iron castings shall conform to the requirements of ASTM A 536.
6. Austempered ductile iron castings shall conform to the requirements of ASTM A 897.

All castings or structural steel units shall conform to the dimensions shown on the plans and shall be designed to support the loadings specified. Each frame and cover or grate unit shall be provided with fastening members to prevent it from being dislodged by traffic but which will allow easy removal for access to the structure. All castings shall be thoroughly cleaned. After fabrication, structural steel units shall be galvanized to meet the requirements of ASTM A 123.

- H. The steps or ladder bars shall be gray or malleable cast iron or galvanized steel. The steps shall be the size, length, and shape shown on the plans and those steps that are not galvanized shall be given a coat of bituminous paint, when directed.

2.2 MECHANICAL JOINT AND PUSH-ON JOINT DUCTILE IRON PIPE AND FITTINGS

- A. Pipe shall conform to the requirements of ANSI/AWWA C151/A21.51 with thickness design in accordance with ANSI/AWWA C150/A21-50, Latest Editions. All pipe shall be tested and marked in accordance with these standards.
1. Pipe diameters equal to or less than 12 inches shall be minimum pressure Class 350 psi.
- B. Pipe for installation below ground shall be supplied in lengths not in excess of a nominal 20 feet. The pipe shall have either mechanical joint or push-on joints with rubber gaskets in accordance with ANSI/AWWA C111/A21.11.
- C. Fittings shall be ductile iron or cast iron mechanical joint in accordance with ANSI/AWWA C110/A21.10 with a minimum pressure rating as follows:
- 350 psi for pipe diameters through 24 inches.
- D. In lieu of the above requirement compact ductile iron mechanical joint fittings in accordance with ANSI/AWWA C153/A21.53 may be used for pipe diameters 12 inches and smaller; minimum pressure Class 350 psi.
- E. Rubber gaskets for joints and fittings shall be made of vulcanized styrene butadiene rubber (SBR) in accordance with ANSI/AWWA C111/A21.11. Tee head nuts and bolt for mechanical joints shall also comply with this standard.
- F. Push-on joint pipe joints shall be in accordance with the applicable parts of ANSI/AWWA C111/A21.11 and shall be American Standard, Fastite type or equal.

2.3 FLANGED JOINT DUCTILE IRON PIPE AND FITTINGS.

- A. All above grade pipe and pipe inside pits, tanks, and pump station structures shall be flanged ductile iron pipe conforming to ANSI/AWWA C115/A21.15, latest edition with a minimum special thickness class of 53.
- B. Minimum dimension for flanged pipe shall be as shown in Table 2.1.

Nominal Pipe Size (in)	Maximum Working Pressure (psi)	Pipe Nominal Thickness* (in)	Pipe OD (in)	Maximum Nominal Length
3	250	0.31	3.96	19'-6"
4	250	0.32	4.80	19'-6"
6	250	0.34	6.90	19'-6"
8	250	0.36	9.05	19'-6"
10	250	0.38	11.10	19'-6"
12	250	0.40	13.20	19'-6"
14	250	0.42	15.30	19'-6"
16	250	0.43	17.40	19'-6"
18	250	0.44	19.50	19'-6"
20	250	0.45	21.60	19'-6"
24	250	0.47	25.80	19'-6"
30	250	0.51	32.00	19'-6"
36	250	0.58	38.30	19'-6"

1. Ductile iron pipe barrels for threaded flanged pipe shall conform to the requirements of ANSI/AWWA C151/A21.51 with taper pipe threads for flanges in accordance with ASME/ANSI B1.20.1.
2. Flanges shall be ductile-iron or gray-iron solid type with an internal taper pipe thread in accordance with ASME/ANSI B1.20.1. They shall be flat-faced with dimensions and bolthole patterns for a water service rating of 250 psi working pressure in accordance with ASME/ANSI B.16.1, Class 125 flanges. Flanges may be back- or spot-faced to conform with flange thickness tolerances. Hollowback flanges are not acceptable.

3. All flanged pipes shall meet the fabrication tolerances specified in ANSI/AWWA C151/A21.51 and shall be inspected, tested and so marked by the manufacturer.
4. Fittings shall be ductile iron or cast iron flanged joint in accordance with ANSI/AWWA C110/A21.10 with a minimum rating of 250 psi working pressure.
5. Nuts, bolts, and gaskets for flanged joints shall be provided by the manufacturer adequate for the type of service and pressure rating of the joint. Gaskets shall be full face, minimum 1/8-inch thick synthetic rubber with molded annular rings.

2.4 JOINT RESTRAINT FOR DUCTILE IRON PIPE

- A. Pipe joint restraint for standard mechanical joints shall be incorporated into the design of the follower gland and shall include a restraining mechanism which, when activated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Flexibility of the joint shall be maintained after burial. Glands shall be manufactured of ductile iron conforming to ASTM A536. Restraining devices shall be of ductile iron heat treated to minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with a standard mechanical joint bell and tee-head bolts conforming to ANSI A21.11 and ANSI/AWWA C153/A21.53. Twist-off nuts shall be used on the restraining devices to ensure proper actuating of the restraining devices. The mechanical joint restraint system shall be designed for a working pressure of 250 psi with a minimum factor of safety of 2. Restrained joint devices shall be Meg-a-Lug as manufactured by Ebba Iron or equal. Standard mechanical joint retainer glands are not acceptable.
- B. Pipe joint restraint for push on joint pipe shall be as follows:

4" - 12": American Standard Fastite joint with Fast-Grip gasket, American Flex-Ring joint or equal.
- C. Pipe joint restraint across flange adapters and couplings shall be by threaded rods as depicted on the Drawings. Threaded rods shall clear the periphery of adapter and coupling flanges and shall span across to the adjacent flange by flange joints. Gusset plates shall be provided as necessary and fabricated out of 3/4-inch thick ASTM A-36 steel plate, dimensions and number as required.

2.5 LININGS FOR DUCTILE IRON PIPE

- A. Ductile iron pipe and fittings for wastewater and sanitary sewage shall be lined by a two component ceramic epoxy with a total thickness of 40 mils minimum meeting the following requirements.
 1. A permeability rating of 0.0 perms when measured by ASTM E96-66, Procedure A. Duration of test shall be 6 weeks.
 2. A direct impact resistance of 125 inches-pounds with no cracking when measured by ASTM D-2794.

3. The ability to build at least 50 mils dry in one coat.
 4. The material shall be re-coatable with itself for at least seven days with no additional surface preparation when exposed to direct summer sun and a temperature of 90 degrees F.
 5. The material shall contain at least 20% by volume of ceramic quartz pigment.
 6. A test and service history demonstrating the ability of the material to withstand the service expected.
 7. No detrimental blistering, pinholing or porosity of the lining will be allowed. Dry film thickness shall be measured by Steel Structures Painting Council Paint Application Specification No. 2 (SSPC-PA2, November 1, 1982). Conformance verification shall be by Inspection:
 - (a) All pipe shall be checked for thickness using a magnetic film thickness gauge;
 - (b) All pipe shall be pinhole detected with a non-destructive 2,500 volt test;
 - (c) Each pipe joint shall be marked to indicate the date that the lining was applied and the numerical sequence of application on that date.
- B. The lining shall be Protecto 401 Ceramic Epoxy manufactured by Vulcan Painters, Inc. or Owner approved equal. Surface preparation, lining application, inspection and testing shall be performed by the pipe manufacturer who shall provide certificates of compliance with these specifications.

2.6 COATINGS AND FINISHES FOR DUCTILE IRON PIPE

- A. All buried or submerged ductile iron pipe and fittings shall receive an exterior asphaltic coating approximately 1 mil thick in accordance with ANSI/AWWA C151A/A21.51.
- B. All above grade pipe and fittings, exposed to view in the finished work or in non-submerged concrete pits or structures, shall not receive the asphaltic coating but shall be shop primed and field painted in accordance with manufacturer's specifications. The pipe shall be color coded green, labeled as to type of service and marked for flow direction. Asphaltic coating on pipe penetrating the ground or inadvertently applied to above grade pipe shall receive a non-bleeding sealer prior to being painted.

2.7 PVC PRESSURE PIPE 4-INCHES IN DIAMETER AND LARGER

- A. Pipe shall have the following properties at 73° F:
 1. Tensile Strength 7,000 psi
 2. Modules of Elasticity in Tension 400,000 psi
 3. Izod Impact Strength 0.65
 4. Cell Designation 12454-A or 12454-B

5. Hydrostatic Design Basis (HDB) 4,000 psi

- B. Pipe shall be cast iron (CI) equivalent outside diameter with Elastomeric rubber gasket push-on joints in accordance with ASTM F477.

Pipe 4-inches through 12-inches in diameter shall be AWWA C900 DR18, Pressure Class 150 psi rated at 73.4° F. Dimensions, tolerances, inspection, testing and pipe marking shall be in accordance with AWWA C900, latest edition.

- C. Fittings for AWWA C900 DR18 PVC Pressure Pipe shall be of ductile iron in accordance with Part 2 of these specifications.

- D. Where pipe restraint is required, it shall be provided by restraining sufficient length of pipe with mechanical type devices. Mechanical restraint for PVC pipe shall meet the following requirements.

1. Push-on Joint pipe restraint: Mechanical devices shall be full circumferential contact compression type consisting of two rings connected across the pipe joint with restraining rods and associated hardware. The pipe bell ring shall be a single piece ductile iron retainer ring that slides over the pipe plain end up to the pipe bell. The pipe plain end ring shall be a two piece ductile iron restrainer with a serrated-face to contact the pipe. The restrainer shall be assembled on the pipe with side clamping bolts and nuts. The design tolerances to which the restrainer is machined will prevent over-tightening which could weaken or damage the pipe. Ductile iron rings shall be ASTM A536, Grade 65-45-12. Connecting Bolts shall be in accordance with ANSI/AWWA C111/A21.11. The restraining devices shall be rated for a working pressure equivalent to the pressure rating of the pipe and shall meet or exceed the requirements of UNI-B-13-94, Recommended Performance Specification for Joint Restraint Devices for Use with PVC Pipe. The devices shall be Uni-Flange Block Buster Series 1350 or Owner approved equal.

2. Mechanical Joint Pipe Restraint: Devices shall have a full circumferential contact compression 2-piece split ring restrainer which is assembled on the PVC pipe with side clamping bolts and nuts. The restrainer shall be designed to attach to Standard Mechanical Joints with extra long T-bolt studs in 4-inch through 12-inch sizes. The device shall be of ductile iron ASTM A536, Grade 65-45-12. Connection bolts and hardware shall be in accordance with ANSI/AWWA C111/A21.11. The restraining devices shall be rated for a working pressure equivalent to the pressure rating of the pipe and shall meet or exceed the requirements of UNI-B-13-94, Recommended Performance Specification for Joint Restraint Devices for Use with PVC Pipe. The devices shall be Uni-Flange Block Buster Series 1300 or Owner approved equal.

2.8 PVC SANITARY GRAVITY SEWER PIPE

- A. Pipe shall have the following properties at 73° F:

1. Tensile Strength	7,000 psi
2. Modules of Elasticity in Tension	400,000 psi
3. Izod Impact Strength	0.65

4. Cell Designation 12454-A or 12454-B
- B. Pipe shall be PVC sewer pipe with integral bell and spigot joints and locked-in elastomeric rubber gaskets in accordance with ASTM D-3212 and ASTM F477.
- C. Pipe 4-inches through 15-inches shall be SDR-35, pipe stiffness PS-46 psi in accordance with ASTM D-3034.
- D. Pipe shall be supplied in lengths not exceeding a nominal 20 feet.

2.9 CHECK VALVES

- A. Check valves for wastewater service shall be cast iron bodied per AWWA C508, latest revision, with integral ANSI Class 125 flanges. Valves shall have a field replaceable centrifugally cast bronze body seat located in place with stainless steel screws. The valve shaft shall be a one-piece shaft of Type 17-4PH steel, which shall extend through both sides of the valve body. An outside lever and weight shall be attached to one side of the shaft: oil filled control-dampening device shall be attached to the other side of the shaft. The valve disc shall be of ASTM A126 Grade B cast iron and the disc seat shall be of BUNA-N. The control device shall consist of a side-mounted, oil-filled cylinder, which provides three (3) closing speed stages. All control stages shall be fully adjustable. Check valves shall be, GA Industries, Flomatic, Apco Series 6100 or Owner approved equal.

2.10 PLUG VALVES

- A. All plug valves shall be eccentric plug valves. Valves shall be as manufactured by DeZurik or Owner approved equal.
- B. Plug valves shall be tested in accordance with AWWA C504-80 Section 5. Each valve shall be performance tested in accordance with Paragraph 5.2 and shall be given a leakage test and hydrostatic test as described in Paragraphs 5.3 and 5.4. The leakage test shall be applied to the face of the plug tending to unseat the valve. The manufacturer shall furnish certified copies of reports covering proof of design testing as described in Section 5.5 of AWWA C504.
- C. Valves shall be of the non-lubricated eccentric type with resilient faced plugs and shall be furnished with end connections as shown on the plans. Flanged valves shall be faced and drilled to the ANSI 125/150 lb. standard. Mechanical joint ends shall be to the AWWA Standard C-111.
- D. Valve bodies shall be of ASTM A126 Class B semi-steel, 31,000-psi tensile strength minimum in compliance with AWWA Standard C507. Port areas for valves 4-inch through 20-inch shall have a minimum area of 80 percent of the nominal pipe diameter area. All exposed nuts, bolts, springs, washers, etc. shall be zinc or cadmium plated. Resilient Plug facings shall be Hycar or Neoprene.
- E. Valves shall be furnished with permanently lubricated stainless steel or oil-impregnated bronze upper and lower plug stem bushings. These bearings shall comply with the AWWA Standard C507, Section B, Paragraphs 8.1, 8.3 and 8.5, and with AWWA Standard C504, Section 10.

- F. Seats in valves 4-inch and larger shall have a welded-in overlay of a high nickel content on all surfaces contacting the plug face and comply with AWWA Standard C507, and with Standard C504.
- G. Valve shaft seals shall be adjustable and comply with AWWA Standard C507 Section 10 and with AWWA C507.
- H. Valve pressure ratings shall be 175 psi for valves through 12-inch and shall be established by hydrostatic tests as specified by ANSI Standard B16.1. Valves shall be capable of providing drip-tight shut-off to the full valve rating with the pressure applied in either direction.
- I. All valves shall be equipped with gear actuators. All gearing shall be enclosed in a semi-steel housing and be suitable for running in a lubricant with seals provided on all shafts to prevent entry of dirt and water into the actuator. All actuator shafts shall be supported on permanently lubricated bronze bearings. Actuators shall clearly indicate valve position and an adjustable stop shall be provided to set closing torque. Valve packing adjustment shall be accessible without disassembly of the actuator.

2.11 VALVE BOXES

All buried valves shall have cast iron three-piece valve boxes. Valve boxes shall be provided with suitable heavy bonnets and extend to such elevation at or slightly above the finished grade surface, as directed by the Owner. The barrel shall be two-piece, sliding type, having 5 ¼-inch shaft. The upper section shall have a flange at the bottom having sufficient bearing area to prevent settling and shall be complete with cast iron cover. Covers shall have "Sewer" cast into the top.

2.12 FLEXIBLE COUPLINGS

Flexible couplings for wastewater service shall be in accordance with Section 02660.

2.13 HARNESSING SYSTEMS

Harnessing systems for wastewater service shall be in accordance with Item Section 02660.

2.14 AIR/VACUUM AND AIR RELEASE VALVES –NOT USED

PART 3 -EXECUTION

3.1 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery and Storage: Delivery and storage of the materials shall be in accordance with manufacturer recommendations, ANSI/AWWA C600, and ANSI/AWWA C605.
- B. Handling: Care shall be taken in loading, transporting and unloading to prevent damage to the pipe or fittings and their respective linings and coatings. Pipe or fittings shall not be rolled off the carrier or dropped. Unloading shall be done by lifting by hand or with a forklift or crane. All pipe or fittings shall be examined before laying, and no piece shall be installed which is found to be defective.

- C. If any defective pipe is discovered after it has been laid it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional expense to the Owner. All pipe and fittings shall be thoroughly cleaned before laying, shall be kept clean until they are used in the work, and when installed or laid, shall conform to the lines and grades required.

3.2 MANHOLES AND INSPECTION HOLES

- A. The Contractor shall do all excavation for structures and structure footings to the lines and grades or elevations, shown on the plans, or as staked by the Engineer. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown. The elevations of the bottoms of footings, as shown on the plans, shall be considered as approximately only; and the Engineer may order, in writing, changes in dimensions or elevations of footings necessary to secure a satisfactory foundation.
- B. Boulders, logs, or any other objectionable material encountered in excavation shall be removed. All rock or other hard foundation material shall be cleaned of all loose material and cut to a firm surface either level, stepped, or serrated, as directed by the Engineer. All seams or crevices shall be cleaned out and grouted. All loose and disintegrated rock and thin strata shall be removed. When concrete is to rest on a surface other than rock, special care shall be taken not to disturb the bottom of the excavation, and excavation to final grade shall not be made until just before the concrete or reinforcing is to be placed.
- C. The Contractor shall do all bracing, sheathing, or shoring necessary to implement and protect the excavation and the structure as required for safety or conformance to governing laws. The cost of bracing, sheathing, or shoring shall be included in the unit price bid for the structure.
- D. Unless otherwise provided, bracing, sheathing, or shoring involved in the construction of this item shall be removed by the Contractor after the completion of the structure. Removal shall be effected in a manner which will not disturb or mar finished masonry. The cost of removal shall be included in the unit price bid for the structure.
- E. After each excavation is completed, the Contractor shall notify the Engineer to that effect; and concrete or reinforcing steel shall be placed after the Engineer has approved the depth of the excavation and the character of the foundation material.
- F. Brick Structures
 - 1. Foundations. A prepared foundation shall be placed for all brick structures after the foundation excavation is completed and accepted. Unless otherwise specified, the base shall consist of reinforced concrete mixed, prepared, and placed in accordance with the requirements of Item P-610.
 - 2. Laying Brick. All brick shall be clean and thoroughly wet before laying so that they will not absorb any appreciable amount of additional water at the time they are laid. All brick shall be laid in freshly made mortar. Mortar that is not used within 45 minutes after water has been added shall be discarded. Retempering of mortar shall not be permitted. An ample layer of mortar shall be spread on the beds and a shallow furrow shall be made in it, which can be readily closed by the laying of the brick. All bed and head joints shall be filled solid with mortar. End joints of

stretchers and side or cross-joints of headers shall be fully buttered with mortar and a shoved joint made to squeeze out mortar at the top of the joint. Any bricks that may be loosened after the mortar has taken its set, shall be removed, cleaned, and relaid with fresh mortar. No broken or chipped brick shall be used in the face, and no spalls or bats shall be used except where necessary to shape around irregular openings or edges; in which case, full bricks shall be placed at ends or corners where possible, and the bats shall be used in the interior of the course. In making closures, no piece of brick shorter than the width of a whole brick shall be used; and wherever practicable, whole brick shall be used and laid as headers.

3. Joints. All joints shall be slushed with mortar at every course, but slushing alone will not be considered adequate for making an acceptable joint. Exterior faces shall be laid up in advance of backing. Exterior faces shall be back plastered or pargeted with a coat of mortar not less than 3/8-inch (9 mm) thick before the backing is laid up. Prior to pargeting, all joints on the back of face courses shall be cut flush. Unless otherwise noted, joints shall be not less than 1/4-inch (6 mm) nor more than 1/2-inch (12 mm) wide and whatever width is adopted shall be maintained uniform throughout the work.
 4. Pointing. Face joints shall be neatly struck, using the weather joint. All joints shall be finished properly as the laying of the brick progresses. When nails or line pins are used the holes shall be immediately plugged with mortar and pointed when the nail or pin is removed.
 5. Cleaning. Upon completion of the work all exterior surfaces shall be thoroughly cleaned by scrubbing and washing down with water and, if necessary to produce satisfactory results, cleaning shall be done with a 5% solution of muriatic acid which shall then be rinsed off with liberal quantities of clean fresh water.
 6. Curing and Cold Weather Protection. In hot or dry weather, or when directed by the Engineer, the brick masonry shall be protected and kept moist for at least 48 hours after laying the brick. Brick masonry work or pointing shall not be done when there is frost in the brick or when the air temperature is below 50 F (10 C) unless the Contractor has on the project ready to use, suitable covering and artificial heating devices necessary to keep the atmosphere surrounding the masonry at a temperature of not less than 60 F (15 C) for the duration of the curing period.
- G. Concrete Structures: Concrete structures shall be built on prepared foundations, conforming to the dimensions and form indicated on the plans. The construction shall conform to the requirements specified in P-610 Structural Portland Cement Concrete. Any reinforcement required shall be placed as indicated on the plans and shall be approved by the Engineer before the concrete is poured.

All invert channels shall be constructed and shaped accurately so as to be smooth, uniform, and cause minimum resistance to flowing water. The interior bottom shall be sloped downward toward the outlet.

- H. Precast Pipe Structures: Precast concrete pipe structures shall be constructed on prepared or previously placed slab foundations and shall conform to the dimensions and locations shown on the plans. All precast concrete pipe sections necessary to build a completed structure

shall be furnished. The different sections shall fit together readily, and all jointing and connections shall be cemented with mortar. The top of the upper precast concrete pipe member shall be suitably formed and dimensioned to receive the metal frame and cover or grate, or other cap, as required. Provision shall be made for any connections for lateral pipe, including drops and leads that may be installed in the structure. The flow lines shall be smooth, uniform, and cause minimum resistance to flow. The metal steps which are embedded or built into the side walls shall be aligned and placed at vertical intervals of 12 inches (300 mm). When a metal ladder replaces the steps, it shall be securely fastened into position.

- I. **Corrugated Metal Structures:** Corrugated metal structures shall be constructed on prepared foundations, conforming to the dimensions and locations as shown on the plans. The structures shall be prefabricated. standard or special fittings shall be furnished to provide pipe connections or branches of correct dimensions. The connections or branches shall be of sufficient length to accommodate connecting bands. The fittings shall be welded in place to the metal structures. When indicated, the structures shall be placed on a reinforced concrete base. The top of the metal structure shall be designed so that either a concrete slab or metal collar may be attached to which can be fastened a standard metal frame and grate or cover. Steps or ladders shall be furnished as shown on the plans.
- J. **Inlet and Outlet Pipes:** Inlet and outlet pipes shall extend through the walls of the structures for a sufficient distance beyond the outside surface to allow for connections but shall be cut off flush with the wall on the inside surface, unless otherwise directed. For concrete or brick structures, the mortar shall be placed around these pipes so as to form a tight, neat connection.
- K. **Placement and Treatment of Castings, Frames, and Fittings:** All castings, frames, and fittings shall be placed in the positions indicated on the plans or as directed by the Engineer, and shall be set true to line and to correct elevation. If frames or fittings are to be set in concrete or cement mortar, all anchors or bolts shall be in place and position before the concrete or mortar is placed. The unit shall not be disturbed until the mortar or concrete has set.

When frames or fittings are to be placed upon previously constructed masonry, the bearing surface or masonry shall be brought true to line and grade and shall present an even bearing surface in order that the entire face or back of the unit will come in contact with the masonry.

The unit shall be set in mortar beds and anchored to the masonry as indicated on the plans or as directed and approved by the Engineer. All units shall set firm and secure.

After the frames or fittings have been set in final position and the concrete or mortar has been allowed to harden for 7 days, then the grates or covers shall be placed and fastened down.

- L. **Installation of Steps:** The steps shall be installed as indicated on the plans or as directed by the Engineer. When the steps are to be set in concrete, they shall be placed and secured in position before the concrete is poured. When the steps are installed in brick masonry, they shall be placed as the masonry is being built. The steps shall not be disturbed or used until the concrete or mortar has hardened for at least 7 days. After this period has elapsed, the steps shall be cleaned and painted, unless they have been galvanized.

When steps are required with precast concrete pipe structures, they shall be cast into the sides of the pipe at the time the pipe sections are manufactured or set in place after the structure is erected by drilling holes in the concrete and cementing the steps in place.

When steps are required with corrugated metal structures, they shall be welded into aligned position at a vertical spacing of 12 inches (300 mm).

In lieu of steps, prefabricated ladders may be installed. In the case of brick or concrete structures, the ladder shall be held in place by grouting the supports in drilled holes. In the case of metal structures, the ladder shall be secured by welding the top support and grouting the bottom support into drilled holes in the foundation or as directed.

- M. After a structure has been completed, the area around it shall be filled with approved material, in horizontal layers not to exceed 8 inches (200 mm) in loose depth, and compacted to the density required in Item P-152. Each layer shall be deposited all around the structure to approximately the same elevation. The top of the fill shall meet the elevation shown on the plans or as directed by the Engineer.
- N. Backfilling shall not be placed against any structure until permission is given by the Engineer. In the case of concrete, such permission shall not be given until the concrete has been in place 7 days, or until tests made by the laboratory under supervision of the Engineer establish that the concrete has attained sufficient strength to provide a factor of safety against damage or strain in withstanding any pressure created by the backfill or the methods used in placing it.

3.3 PIPE INSTALLATION

- A. Below grade ductile iron pipe and fittings shall be installed in accordance with requirements of ANSI/AWWA C-600 and manufacturer recommendations. Pipes shall be laid to the lines and grades shown on the Drawings with a minimum of 3 feet of cover from proposed finished grades. Pipes shall be laid at a constant slope between elevations specified. Pipe joints may be deflected to a maximum of 75% of manufacturer recommendations to establish alignment, slope and grade. Pipe trenching bedding and backfill shall be in accordance with Section 02221 and the Drawings.
- B. Flanged ductile iron pipe and fittings shall be installed true to alignment and adequately supported. All valves, fittings, equipment, and appurtenances needed upon the pipelines shall be set and jointed as indicated on the Drawings or as required. All pipe and appurtenances connected to equipment shall be supported in such manner as to prevent any strain being imposed on the equipment. Supports shall be provided at each fitting/valve/appurtenance or combination thereof and at a maximum spacing of 6 feet.
- C. All field cutting of pipe shall be performed in accordance with the requirements of ANSI/AWWA C600 and manufacturer recommendations. Field touch-up of linings shall be per manufacturer recommendations.
- D. Below-grade PVC pipe shall be installed in accordance with requirements of ANSI/AWWA C-605, manufacturer recommendations and ASTM D2321. Pipes shall be laid to the lines and grades shown on the Drawings with a minimum of 3 feet of cover from proposed finished grades. Pipes shall be laid at a constant slope between elevations specified. Pipe

joints may be deflected to a maximum of 75% of manufacturer recommendations to establish alignment, slope and grade, except for gravity sewers which shall be surveyed in straight to required grade. Pipe trenching, bedding and backfill shall be in accordance with these Specifications, Section 02221 and the Drawings.

3.4 CLEANING

- A. At the conclusion of the work, the Contractor shall thoroughly clean the new pipe lines by flushing with water or other means to remove all dirt, stones or other material which may have entered the line during the construction period. The Contractor shall pay for and provide all water, pumps, piping, and related equipment required for cleaning at no additional cost to the owner. Wastewater may not be used for cleaning.

After the backfill is completed, the Contractor shall dispose of all surplus material, dirt, and rubbish from the site. Surplus dirt may be deposited in embankments, shoulders, or as ordered by the Engineer. The Contractor shall restore all disturbed areas to their original condition.

After all work is completed, the Contractor shall remove all tools and equipment, leaving the entire site free, clear, and in good condition.

3.5 CONNECTIONS TO EXISTING STRUCTURES AND SEWERS

- A. Make connections to existing manholes as required. Provisions have been made in some of the existing structures for future connections and may require only the removal of a plug and the connection of the proposed line, while other connections will require cutting into the existing structure. Exercise care in cutting into the existing structure, using only core drilling, and repair any damage done to the structure as required by the Engineer and at no cost to the Owner. Install drop connections, if required, as detailed on the Drawings.

3.6 HYDROSTATIC PRESSURE AND LEAKAGE TESTING

- A. Hydrostatic tests shall consist of a pressure test and a leakage test. Hydrostatic tests shall be conducted on all newly laid pressure pipes, joints, and valves including all service lines. Air testing of pressure pipes will not be permitted under any circumstance. Tests shall be made on sections not exceeding 2,000 feet. The Contractor shall furnish all closure pieces in the pipe as required. Equipment to be furnished by the Contractor shall include, but not be limited to, graduated containers, pressure gauges, hydraulic force pumps, and suitable hoses and piping. The Engineer will monitor and approve a satisfactory test. The Contractor shall pay for, provide, and dispose of all flushing and test water at no additional cost to the Owner. Wastewater may not be used for testing.
- B. The Contractor may conduct hydrostatic tests after the trench has been partially backfilled with the joints left exposed for inspection for his informational purposes only. The hydrostatic tests for acceptance shall only be conducted after the trenches have been completely backfilled and compacted as specified. Where any section of pipe is provided with concrete thrust blocking, tests will not be made until at least five (5) days have elapsed after the thrust blocking is installed. If high early strength cement is used for the concrete thrust blocking, the time may be reduced to 24 hours.

- C. All pressure pipe sections to be tested shall be subjected to hydrostatic pressure and leakage tests. Test pressures for the various applications shall be as follows:

Pumped pressure force mains: 100 psi

- D. The duration of pressure and leakage tests shall be for periods of 2 hours each. If during the tests, the integrity of the tested line is in question, the Engineer may require 6 hour tests. The basic provisions of AWWA C-600 shall be applicable.

- E. Pressure Test:

Each section of pipe to be tested, as determined by the Engineer, shall be slowly filled with water and the specified test pressure shall be applied by means of a pump connected to the pipe in a satisfactory manner. Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, and appropriate valves installed to ensure bleeding of all air from the main. If defective pipes, fittings, valves, or hydrants are discovered in consequence of the pressure test, all such items shall be removed and replaced by the Contractor with sound material and tests shall be repeated until satisfactory results are obtained. Provisions of AWWA C-600, where applicable, shall apply.

- F. Leakage Test:

1. After completion of the pressure test, a leakage test shall be conducted to determine the quantity of water lost by leakage under the specified test pressure. Applicable provisions of AWWA C-600 shall apply.
2. Allowable leakage in gallons per hour for the pipeline shall not be greater than that determined by the formula:

$$L = \frac{SD(P)^{0.5}}{133,200}$$

Where: L = Allowable leakage in gallons per hour.
S = Length of pipe tested, in feet.
D = Nominal diameter of pipe in inches.
P = Average test pressure during leakage test in pounds per square inch gauge.

3. Leakage is defined as the quantity of water to be supplied in the newly laid pipe or any valved section under test, which is necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled. Should any test of pipe laid disclose leakage greater than that allowed, the Contractor shall locate and replace or repair the defective joints, pipe or valves until the leakage from subsequent testing is within the specified allowance.

3.7 LOW PRESSURE AIR TESTING

- A. Low-pressure air test shall be performed on all sanitary gravity sewer piping in accordance with UNI-B-6-79 "Recommended Practice for Low Pressure Air Testing of Installed Sewer Pipe."

- B. Test sections between adjacent manholes with a test pressure of 4.0 psig greater than the average back pressure of any groundwater head above the pipe invert, but in no case shall it be greater than 9.0 psig. If no groundwater over the pipe invert is present the minimum test pressure shall be 4.0 psig.
- C. Before testing the Contractor shall flush all gravity lines to obtain free flow through each line, and determine groundwater levels to adjust the test pressure accordingly.
- D. Procedure:
 - 1. Low-pressure air shall be slowly introduced into the sealed line until the internal air pressure reaches the specified test pressure. When temperatures have been equalized and pressure stabilized at the specified test pressure, the air supply shall be shut off.
 - 2. If the time shown in Table 3.1 elapses before the air pressure drops 1.0 psig, the section undergoing the test shall have passed. Times shall be interpolated for lengths other than those shown. Times for 100-foot lengths are minimum.
 - 3. Should the section fail to meet test requirements, the Contractor shall determine the sources of leakage, make necessary repairs and repeat the test until the section passes.

Table 3.1
Specification Time Required for a 1.0 psig Pressure Drop
for Size and Length of Pipe Indicated for Q=0.0015

Pipe Dia. (in.)	Minimum Time (min:sec)	Length for Min. Time (ft)	Time for Longer Length (sec)	Specification Time for Length (L) Shown (Min:Sec)						
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft
6	5:40	398	0.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36

- 4. Inspection of gravity sewers by the Owner may be a condition of acceptance. Internal video inspection shall be performed by the Owner to check for alignment and deflection. The television inspection shall also be used to check for cracked, broken or otherwise defective pipe, and overall pipe integrity. Five percent deflection mandrel tests may also be performed.

3.7 CORRECTION OF NON-CONFORMING WORK

All non-conforming work shall be repaired or replaced by the Contractor at no additional expense to the Owner. Non-conforming work shall be defined as failure to adhere to any specific or implied directive of these specifications and/or the Drawings, including but not limited to pipe not laid straight, true to the lines and grades as shown on the drawings, damaged or unacceptable materials, excessive misalignment or diameter ring deflection in pipe due to bedding, backfilling or installation, visible or detectible leakage and failure to pass any specified test or inspection.

METHOD OF MEASUREMENT

- A. The length of sanitary line to be paid for shall be the number of linear feet of sanitary line in place, completed, and approved. It shall be measured along the centerline of the pipe from end to end. Fittings shall be incidental to the respective sanitary liner for which they are a part. The price does include all materials, preparation, excavation, installation, labor, equipment, tools, supplies and incidentals to complete this work.
- B. Service laterals, oil-water separators, manholes, and other fittings shall be measured by each unit in place, completed, and approved.

BASIS OF PAYMENT

- A. Payment shall be made at the contract unit price per linear foot for waterline. This price shall be full compensation to the Contractor for furnishing all materials, preparation, excavation, installation, labor, equipment, tools, supplies and incidentals to complete this work.
- B. The accepted quantities of service laterals, oil-water separators, manholes, and other fittings will be paid for at the contract unit price per each, complete and in place. This price shall be full compensation to the Contractor for furnishing all materials and for preparation, excavation, installation and backfilling of these materials; furnishing and installation of such specials and connections to pipes and other structures as may be required to complete the items as shown in the plans; and for all labor, equipment, tools, supplies, and incidentals to complete this work.
- C. Modification to existing stormwater inlets shall be incidental to the cost of Pay Item 02730-5 or 02730-6.

Payment shall be made under:

- Item 02730-1 Sanitary Sewer Infrastructure – Lump Sum (LS)*
- Item 02730-2 Lift Station – Each (EA)*

END OF SECTION 02730

**SECTION F-162
CHAIN-LINK FENCES**

162-1.1 Description.

This item shall consist of furnishing and erecting a chain-link fence in accordance with these specifications and the details shown on the plans and in conformity with the lines and grades shown on the plans or established by the Engineer.

162-2 Materials

162-2.1 Fabric.

The fabric shall be woven with a 9-gauge galvanized steel wire mesh and shall meet the requirements of ASTM A 392, Class 2.

162-2.2 Barbed Wire

Barbed wire shall be 2-strand 12-1/2 gauge zinc-coated wire with 4-point barbs and shall conform to the requirements of ASTM A 121, Class 3, Chain Link Fence Grade.

162-2.3 Posts, Rails, and Braces

Posts, rails, and braces furnished for use in conjunction with zinc-coated, zinc-5% aluminum mischmetal alloy coated, or aluminum-coated steel fabric shall be of zinc-coated steel, zinc/polymer-coated steel, zinc-5% aluminum mischmetal alloy coated steel framework, or composite posts. Those furnished for use in conjunction with aluminum alloy fabric shall be aluminum alloy.

Line posts, rails, and braces shall be galvanized steel pipe conforming to the requirements of ASTM F 1083.

Post, rails, and braces, with the exception of galvanized steel (Schedule 40 weight) or aluminum alloy (Schedule 40 weight) which conform to the requirements of ASTM F 1083, shall demonstrate the ability to withstand testing in salt spray in accordance with ASTM B 117 as follows:

External: 1,000 hours with a maximum of 5% red rust.

Internal: 650 hours with a maximum of 5% red rust.

The dimensions of the posts, rails, and braces shall be in accordance with Tables I through VI of Fed. Spec. RR-F-191/3.

162-2.4 Gates

Gate frames shall consist of galvanized steel pipe and shall conform to the specifications for the same material under paragraph 162-2.3. The fabric shall be of the same type material as used in the fence.

162-2.5 Wire Ties And Tension Wires

Wire ties for use in conjunction with a given type of fabric shall be of the same material and coating weight identified with the fabric type. Tension wire shall be 7-gauge marcelled steel wire with the same coating as the fabric type and shall conform to ASTM A 824.

All material shall conform to Fed. Spec. RR-F-191/4.

162-6 Miscellaneous Fittings and Hardware

Miscellaneous steel fittings and hardware for use with zinc-coated steel fabric shall be of commercial grade steel or better quality, wrought or cast as appropriate to the article, and sufficient in strength to provide a balanced design when used in conjunction with fabric posts, and wires of the quality specified herein. All steel fittings and hardware shall be protected with a zinc coating applied in conformance with ASTM A 153. Barbed wire support arms shall withstand a load of 250 pounds (113 kg) applied vertically to the outermost end of the arm.

162-2.7 Concrete

Concrete shall be of a commercial grade with a minimum 28-day compressive strength of 2500 psi (17 240 kPa).

162-2.8 Marking

Each roll of fabric shall carry a tag showing the kind of base metal (steel, aluminum, or aluminum alloy number), kind of coating, the gauge of the wire, the length of fencing in the roll, and the name of the manufacturer. Posts, wire, and other fittings shall be identified as to manufacturer, kind of base metal (steel, aluminum, or aluminum alloy number), and kind of coating.

162-3 Construction Methods

162-3.1 Clearing Fence Line

All trees, brush, stumps, logs, and other debris which would interfere with the proper construction of the fence in the required location shall be removed a minimum width of 2 feet (61 cm) on each side of the fence centerline before starting fencing operations. The cost of removing and disposing of the material shall not constitute a pay item and shall be considered incidental to fence construction.

162-3.2 Installing Posts

All posts shall be set in concrete at the required dimension and depth and at the spacing shown on the plans.

The concrete shall be thoroughly compacted around the posts by tamping or vibrating and shall have a smooth finish slightly higher than the ground and sloped to drain away from the posts. All posts shall be set plumb and to the required grade and alignment. No materials shall be installed on the posts, nor shall the posts be disturbed in any manner within 7 days after the individual post footing is completed.

Should rock be encountered at a depth less than the planned footing depth, a hole 2 inches (50 mm) larger than the greatest dimension of the posts shall be drilled to a depth of 12 inches (300 mm). After the posts are set, the remainder of the drilled hole shall be filled with grout, composed of one part Portland cement and two parts mortar sand. Any remaining space above the rock shall be filled with concrete in the manner described above.

In lieu of drilling, the rock may be excavated to the required footing depth. No extra compensation shall be made for rock excavation.

162-3.3 Installing Top Rails

The top rail shall be continuous and shall pass through the post tops. The coupling used to join the top rail lengths shall allow for expansion.

162-3.4 Installing Braces

Horizontal brace rails, with diagonal truss rods and turnbuckles, shall be installed at all terminal posts.

162-3.5 Installing Fabric

The wire fabric shall be firmly attached to the posts and braced in the manner shown on the plans. All wire shall be stretched taut and shall be installed to the required elevations. The fence shall generally follow the contour of the ground, with the bottom of the fence fabric no less than 1 inch (25 mm) or more than 4 inches (100 mm) from the ground surface. Grading shall be performed where necessary to provide a neat appearance.

At locations of small natural swales or drainage ditches and where it is not practical to have the fence conform to the general contour of the ground surface, longer posts may be used and multiple strands of barbed wire stretched thereon to span the opening below the fence. The vertical clearance between strands of barbed wire shall be 6 inches (150 mm) or less.

162-3.6 Electrical Grounds

Electrical grounds shall be constructed at 500-foot (150 m) intervals. The ground shall be accomplished with a copper clad rod 8 feet (240 cm) long and a minimum of 5/8 inch (15 mm) in diameter driven vertically until the top is 6 inches (150 mm) below the ground surface. A No. 6 solid copper conductor shall be clamped to the rod and to the fence in such a manner that each element of the fence is grounded. Installation of ground rods shall not constitute a pay item and shall be considered incidental to fence construction.

162-4 Method of Measurement

162-4.1 Chain-link fence will be measured for payment by the linear foot (meter). Measurement will be along the top of the fence from center to center of end posts, excluding the length occupied by gate openings.

162-5 Basis of Payment

162-5.1 Payment for chain-link fence will be made at the contract unit price per linear foot (meter). Payment for driveway or walkway gates shall be incidental to the price per linear foot of fence.

The price shall be full compensation for furnishing all materials, and for all preparation, erection, and installation of these materials, and for all labor equipment, tools, and incidentals necessary to complete the item.

162-5.2 Payment: Payment will be made under:

Item No. F-162-1 Fencing - per Linear Foot (LF).

Item No. F-162-2 5' Pedestrian Gate With Controls - per Each (EA).

162-6 Material Requirements

ASTM A 121 Zinc-Coated (Galvanized) Steel Barbed Wire

ASTM A 123 Zinc (Hot Galvanized) Coatings on Products Fabricated from Rolled, Pressed,
and Forged Steel Shapes, Plates, Bars, and Strip

- ASTM A 153 Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- ASTM A 392 Zinc-Coated Steel Chain-Link Fence Fabric
- ASTM A 446 Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality
- ASTM A 491 Aluminum-Coated Steel Chain-Link Fence Fabric
- ASTM A 569 Steel, Carbon (0.15 Maximum, Percent), Hot Rolled Sheet and Strip Commercial Quality
- ASTM A 570 Hot-Rolled Carbon Steel Sheet and Strip Structural Quality
- ASTM A 572 High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality
- ASTM A 585 Aluminum-Coated Steel Barbed Wire
- ASTM A 824 Metallic-Coated Steel Marcellled Tension Wire for Use With Chain Link Fence
- ASTM B 117 Standard Test Method of Salt Spray (Fog) Testing
- ASTM B 221 Aluminum-Alloy Extruded Bars, Rods, Wire Shapes and Tubes
- ASTM F 668 Poly(vinyl Chloride)(PVC)-Coated Steel Chain-Link Fence
- ASTM F 1043 Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework
- ASTM F 1083 Pipe, Steel, Hot-Dipped Zinc-coated (galvanized) Welded, for Fence Structures
- ASTM F 1183 Aluminum Alloy Chain Link Fence Fabric
- ASTM F 1234 Protective Coatings on Steel Framework for Fences
- ASTM G 23 Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials
- ASTM G 26 Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials
- ASTM G 53 Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials
- Fed. Spec. Fencing, Wire and Post, Metal (Chain-Link Fence Posts, Top Rails and RR-F-191/3 Braces)
- Fed. Spec. Fencing, Wire and Post, Metal (Chain-Link Fence Accessories) RR-F-191/4

END SECTION F-162

**ITEM P-620
RUNWAY AND TAXIWAY MARKING**

DESCRIPTION

620-1.1 This item shall consist of the preparation and painting of numbers, markings, and stripes on the surface of runways, taxiways, and aprons, in accordance with these specifications and at the locations shown on the plans, or as directed by the Resident Project Representative (RPR). The terms “paint” and “marking material” as well as “painting” and “application of markings” are interchangeable throughout this specification.

MATERIALS

620-2.1 MATERIALS ACCEPTANCE. The Contractor shall furnish manufacturer’s certified test reports, for materials shipped to the project. The certified test reports shall include a statement that the materials meet the specification requirements. This certification along with a copy of the paint manufacturer’s surface preparation; marking materials, including adhesion, flow promoting and/or floatation additive; and application requirements must be submitted and approved by the Resident Project Representative (RPR) prior to the initial application of markings. The reports can be used for material acceptance or the RPR may perform verification testing. The reports shall not be interpreted as a basis for payment. The Contractor shall notify the RPR upon arrival of a shipment of materials to the site. All material shall arrive in sealed containers that are easily quantifiable for inspection by the RPR.

620-2.2 MARKING MATERIALS.

Table 1. Marking Materials

Paint ¹				Glass Beads ²	
Type	Color	Fed Std. 595 Number	Application Rate Maximum	Type	Application Rate Minimum
Type II	Yellow	33538 or 33655	115 ft ² /gal (2.8 m ² /l)	III	10 lb/gal (1.2 kg/l)
Type II	White	37925	115 ft ² /gal (2.8 m ² /l)	None	N/A
Type II	Black	37038	115 ft ² /gal (2.8 m ² /l)	None	N/A

¹ See paragraph 620-2.2a

² See paragraph 620-2.2b

a. Paint. Paint shall be waterborne in accordance with the requirements of this paragraph. Paint colors shall comply with Federal Standard No. 595.

Waterborne. Paint shall meet the requirements of Federal Specification TT-P-1952F, Type II. The non-volatile portion of the vehicle for all paint types shall be composed of a 100% acrylic polymer as determined by infrared spectral analysis.

b. Reflective media. Glass beads for white and yellow paint shall meet the requirements for Federal Specification TT-B-1325D Type III.

Glass beads shall be treated with all compatible coupling agents recommended by the manufacturers of the paint and reflective media to ensure adhesion and embedment.

Glass beads shall not be used in black and green paint.

Type III glass beads shall not be used in red and pink paint.

CONSTRUCTION METHODS

620-3.1 WEATHER LIMITATIONS. Painting shall only be performed when the surface is dry, and the ambient temperature and the pavement surface temperature meet the manufacturer's recommendations in accordance with paragraph 620-2.1. Painting operations shall be discontinued when the ambient or surface temperatures does not meet the manufacturer's recommendations. Markings shall not be applied when the wind speed exceeds 10 mph unless windscreens are used to shroud the material guns. Markings shall not be applied when weather conditions are forecasts to not be within the manufacturers' recommendations for application and dry time.

620-3.2 EQUIPMENT. Equipment shall include the apparatus necessary to properly clean the existing surface, a mechanical marking machine, a bead dispensing machine, and such auxiliary hand-painting equipment as may be necessary to satisfactorily complete the job.

The mechanical marker shall be an atomizing spray-type or airless type marking machine with automatic glass bead dispensers suitable for application of traffic paint. It shall produce an even and uniform film thickness and appearance of both paint and glass beads at the required coverage and shall apply markings of uniform cross-sections and clear-cut edges without running or spattering and without over spray. The marking equipment for both paint and beads shall be calibrated daily.

620-3.3 PREPARATION OF SURFACES. Immediately before application of the paint, the surface shall be dry and free from dirt, grease, oil, laitance, or other contaminants that would reduce the bond between the paint and the pavement. Use of any chemicals or impact abrasives during surface preparation shall be approved in advance by the RPR. After the cleaning operations, sweeping, blowing, or rinsing with pressurized water shall be performed to ensure the surface is clean and free of grit or other debris left from the cleaning process.

a. Preparation of new pavement surfaces. The area to be painted shall be cleaned by broom, blower, water blasting, or by other methods approved by the RPR to remove all contaminants, including PCC curing compounds, minimizing damage to the pavement surface.

b. Preparation of pavement to remove existing markings. Existing pavement markings shall be removed by rotary grinding, water blasting, or by other methods approved by the RPR minimizing damage to the pavement surface. The removal area may need to be larger than the area of the markings to eliminate ghost markings. After removal of markings on asphalt pavements, apply a fog seal or seal coat to 'block out' the removal area to eliminate 'ghost' markings.

c. Preparation of pavement markings prior to remarking. Prior to remarking existing markings, loose existing markings must be removed minimizing damage to the pavement surface, with a method approved by the RPR. After removal, the surface shall be cleaned of all residue or debris.

Prior to the application of markings, the Contractor shall certify in writing that the surface is dry and free from dirt, grease, oil, laitance, or other foreign material that would prevent the bond of the paint to the pavement or existing markings. This certification along with a copy of the paint manufactures application and surface preparation requirements must be submitted to the RPR prior to the initial application of markings.

620-3.4 LAYOUT OF MARKINGS. The proposed markings shall be laid out in advance of the paint application. The locations of markings to receive glass beads shall be shown on the plans.

620-3.5 APPLICATION. A period of 30 days shall elapse between placement of surface course or seal coat and application of the permanent paint markings. Paint shall be applied at the locations and to the dimensions and spacing shown on the plans. Paint shall not be applied until the layout and condition of the surface has been approved by the RPR.

The edges of the markings shall not vary from a straight line more than 1/2 inch (12 mm) in 50 feet (15 m), and marking dimensions and spacing shall be within the following tolerances:

Marking Dimensions and Spacing Tolerance

Dimension and Spacing	Tolerance
36 inch (910 mm) or less	±1/2 inch (12 mm)
greater than 36 inch to 6 feet (910 mm to 1.85 m)	±1 inch (25 mm)
greater than 6 feet to 60 feet (1.85 m to 18.3 m)	±2 inch (50 mm)
greater than 60 feet (18.3 m)	±3 inch (76 mm)

The paint shall be mixed in accordance with the manufacturer's instructions and applied to the pavement with a marking machine at the rate shown in Table 1. The addition of thinner will not be permitted.

Glass beads shall be distributed upon the marked areas at the locations shown on the plans to receive glass beads immediately after application of the paint. A dispenser shall be furnished that is properly designed for attachment to the marking machine and suitable for dispensing glass beads. Glass beads shall be applied at the rate shown in Table 1. Glass beads shall not be applied to black paint or green paint. Glass beads shall adhere to the cured paint or all marking operations shall cease until corrections are made. Different bead types shall not be mixed. Regular monitoring of glass bead embedment and distribution should be performed.

620-3.6 APPLICATION--PREFORMED THERMOPLASTIC AIRPORT PAVEMENT MARKINGS.

Preformed thermoplastic pavement markings not used.

620-3.7 CONTROL STRIP. Prior to the full application of airfield markings, the Contractor shall prepare a control strip in the presence of the RPR. The Contractor shall demonstrate the surface preparation method and all striping equipment to be used on the project. The marking equipment must achieve the prescribed application rate of paint and population of glass beads (per Table 1) that are properly embedded and evenly distributed across the full width of the marking. Prior to acceptance of the control strip, markings must be evaluated during darkness to ensure a uniform appearance.

620-3.8 RETRO-REFLECTANCE. Reflectance shall be measured with a portable retro-reflectometer meeting ASTM E1710 (or equivalent). A total of 6 readings shall be taken over a 6 square foot area with 3 readings taken from each direction. The average shall be equal to or above the minimum levels of all readings which are within 30% of each other.

Minimum Retro-Reflectance Values

Material	Retro-reflectance mcd/m ² /lux		
	White	Yellow	Red
Initial Type III	600	300	35

620-3.9 PROTECTION AND CLEANUP. After application of the markings, all markings shall be protected from damage until dry. All surfaces shall be protected from excess moisture and/or rain and from disfiguration by spatter, splashes, spillage, or drippings. The Contractor shall remove from the work area all debris, waste, loose reflective media, and by-products generated by the surface preparation and application operations to the satisfaction of the RPR. The Contractor shall dispose of these wastes in strict compliance with all applicable state, local, and federal environmental statutes and regulations.

METHOD OF MEASUREMENT

620-4.1b The quantity of markings shall be paid for shall be measured by the number of square feet (square meters) of painting.

620-4.1c No separate payment shall be made for reflective media.

BASIS OF PAYMENT

620-5.1 This price shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the item complete in place and accepted by the RPR in accordance with these specifications.

620-5.1a Payment for surface preparation shall be made at the contract price for incidental to the marking item of which it is a part.

620-5.2b Payment for markings shall be made at the contract price for the number of square feet (square meters) of paint.

620-5.3c Payment for reflective media shall be incidental to paint item of which it is a part.

Payment will be made under:

- | | |
|---------------------|--|
| Item P-620-1 | Airfield Pavement Markings with Reflective Media, Yellow – per Square Foot (SF) |
| Item P-620-2 | Airfield Pavement Markings without Reflective Media, Black – per Square Foot (SF) |

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

- | | |
|------------|---|
| ASTM D476 | Standard Classification for Dry Pigmentary Titanium Dioxide Products |
| ASTM D968 | Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive |
| ASTM D1652 | Standard Test Method for Epoxy Content of Epoxy Resins |
| ASTM D2074 | Standard Test Method for Total, Primary, Secondary, and Tertiary Amine Values of Fatty Amines by Alternative Indicator Method |
| ASTM D2240 | Standard Test Method for Rubber Property - Durometer Hardness |
| ASTM D7585 | Standard Practice for Evaluating Retroreflective Pavement Markings Using Portable Hand-Operated Instruments |
| ASTM E303 | Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester |
| ASTM E1710 | Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer |
| ASTM E2302 | Standard Test Method for Measurement of the Luminance Coefficient Under Diffuse Illumination of Pavement Marking Materials Using a Portable Reflectometer |
| ASTM G154 | Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials |

Code of Federal Regulations (CFR)

40 CFR Part 60, Appendix A-7, Method 24
Determination of volatile matter content, water content, density,
volume solids, and weight solids of surface coatings

29 CFR Part 1910.1200 Hazard Communication

Federal Specifications (FED SPEC)

FED SPEC TT-B-1325D Beads (Glass Spheres) Retro-Reflective

FED SPEC TT-P-1952F Paint, Traffic and Airfield Marking, Waterborne

FED STD 595 Colors used in Government Procurement

Commercial Item Description

A-A-2886B Paint, Traffic, Solvent Based

Advisory Circulars (AC)

AC 150/5340-1 Standards for Airport Markings

AC 150/5320-12 Measurement, Construction, and Maintenance of Skid Resistant
Airport Pavement Surfaces

END OF ITEM P-620

SECTION 1A

TERMITE CONTROL TREATMENT

1A-01. **GENERAL CONDITIONS:**

The General and Special Conditions, Division II, Sections E and F of these specifications shall apply to and form a part of this Section as if written in full herein.

1A-02. **SCOPE:**

The compacted soil under all new interior concrete floor slabs and around all foundation walls shall be chemically treated prior to vapor barrier being placed. Materials, applications, and standards shall comply with the Florida Building Code 2020, Section 1816.

1A-03. **MATERIALS:**

Shall be Termidor or a chemical that is approved by the State of Florida for pretreatment. Proof shall be provided that no toxic effects to humans or beneficial plant or animal life will result from its use.

1A-04. **RATES OF APPLICATION:**

- A. Rate of application shall be as per manufacturer's label for chemical use at full label rate.
- B. Treatment shall be full coverage below the concrete slabs and along the inside of all foundation walls or interior partitions, and around any openings in the interior of the slab cut or left for pipes, conduits, etc.

1A-05. **MATERIAL SAMPLE:**

Prior to application of the chemical, if required by Architect, this contractor shall, in the presence of the Architect, fill a sealable sample bottle of at least 8 fluid oz. of the mixture to be applied. Testing of the mixture shall be by the Entomology Department, State of Florida Department of Agriculture. Label of the mixture used shall be provided with the sample of mixture.

1A-06. **APPLICATION TECHNIQUE:**

Treatment shall not be made when the soil is excessively wet or immediately after heavy rains to avoid surface flow of the toxicant from the application site. Unless the treated soil is to be promptly covered with drainage fill and vapor barrier, adequate precautions must be taken to prevent disturbances of the treatment and human or animal contact with the treated soil.

POST TREATMENT:

Upon completion of construction and completion of all grading around the building and in accordance with material label a final application shall be made entirely around the perimeter of the building and at the rate as directed on the materials label. **Post treatment shall be done at the time of the substantial completion inspection and the Architect shall be present.**

1A-08. SUBMITTAL:

Prior to application, submit all information showing type of chemical and rate of application for approval.

1A-09. WARRANTY:

After all the above has been done, the termite control subcontractor shall provide the Owner a written five (5) year warranty fully guaranteeing his work and providing any treatment and repairs necessary during that period. Five-year warranty shall include all inspections that may be required under the warranty.

END OF SECTION

**SECTION 5D
COLD-FORMED METAL FRAMING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Exterior non-load-bearing wall framing.
 - 2. Ceiling joist framing.
 - 3. Soffit framing.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for masonry shelf angles and connections.
 - 2. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.
 - 3. Section 092216 "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of cold-formed steel framing product and accessory. B.

Shop Drawings:

- 1. Include layout, spacing, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
 - 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
- C. Delegated-Design Submittal: For cold-formed steel framing.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Horizontal drift deflection clips
7. Miscellaneous structural clips and accessories.

C. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated. B.

Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.

B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated.
2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Interior Load-Bearing Wall Framing: Horizontal deflection of 1/360 of the wall height under a horizontal load of 5 lb./sq. ft.
 - b. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/360 or 1/600 on walls supporting brick veneer of the wall height.
 - c. Ceiling Joist Framing: Vertical deflection of 1/360 of the span for live loads and 1/240 for total loads of the span.
3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as

follows:

- a. Upward and downward movement of 1/2 inch.
5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- C. Cold-Formed Steel Framing Design Standards:
1. Floor and Roof Systems: AISI S210.
 2. Wall Studs: AISI S211.
 3. Headers: AISI S212.
 4. Lateral Design: AISI S213.
- D. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.
- E. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 COLD-FORMED STEEL FRAMING, GENERAL

- A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
1. Grade: As required by structural performance.
 2. Coating: G90 or equivalent.
- B. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
1. Grade: As required by structural performance.
 2. Coating: G90.

2.3 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0428 inch.
 2. Flange Width: 1-5/8 inches.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: Matching steel studs.
 2. Flange Width: 1-1/4 inches.

- C. Vertical Deflection Clips: Manufacturer's standard bypass clips, capable of

accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

2.4 CEILING JOIST FRAMING

- A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, punched with standard holes, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch.
 - 2. Flange Width: 1-5/8 inches, minimum.

2.5 SOFFIT FRAMING

- A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch.
 - 2. Flange Width: 1-5/8 inches, minimum.

2.6 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
 - 1. Supplementary framing.
 - 2. Bracing, bridging, and solid blocking.
 - 3. Web stiffeners.
 - 4. Anchor clips.
 - 5. End clips.
 - 6. Gusset plates.
 - 7. Stud kickers and knee braces.
 - 8. Joist hangers and end closures.
 - 9. Hole reinforcing plates.
 - 10. Backer plates.

2.7 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

- B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by mechanically deposition according to ASTM B 695, Class 50.
- C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
- D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

2.8 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B.
- B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1-part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, with fluid consistency and 30-minute working time.
- D. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.

2.9 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

screw penetrating joined members by no fewer than three exposed screw threads.

4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
 - C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.
- D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
 1. Cut framing members by sawing or shearing; do not torch cut.

fastening, or riveting. Wire tying of framing members is not permitted.

- a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- H. Install insulation, specified in Section 072100 "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.
- J. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.3 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
1. Stud Spacing: 16 inches.
- C. Set studs plumb, except as needed for diagonal bracing or required for no plumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
1. Connect vertical deflection clips to bypassing studs and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop

Drawings but not more than 48 inches apart. Fasten at each stud intersection.

- a. Install solid blocking at centers indicated on Shop Drawings.
2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.4 FIELD QUALITY CONTROL

- A. Testing: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Remove and replace work where test results indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 5F

PRE-ENGINEERED METAL BUILDING SYSTEM

5F-01. **GENERAL:**

The General and Special Conditions, Division II, Sections E and F of these specifications shall apply to and form a part of this Section as if written in full herein.

5F-02. **SCOPE:**

Work described in this Section and as shown on the Drawings shall consist of furnishing all labor, materials and equipment for the complete fabrication and erection of all components for the pre-engineered steel building which shall be constructed to be weather-tight, watertight and in compliance with the following specifications.

5F-03. **MANUFACTURER:**

The pre-engineered metal building specifications are based on Butler Building Systems (Butler Building Corporation) rigid frame gable (LFR).

Other pre-engineered metal building manufacturers will be acceptable providing compliance is met in all respects to the following specifications.

5F-04. **SHOP DRAWINGS:**

- A. Detail drawings shall be submitted in quadruplicate for approval after award of contract and before fabrication has begun.
- B. Shop drawings shall include anchor bolt setting plan, framing plans, framing elevations, rigid frame, purlin girt and bracing details as well as drawings and details necessary to clearly indicate the scope of the work and proper assembly of the building.
- C. Shop drawings shall be signed and sealed by a Florida Registered Engineer, and it shall be stated by the Engineer that the system will comply with the uplift requirements as stated herein.
- D. A product approval number and product approval notice of acceptance will be required to comply with the 2023 Florida Building Code with applicable supplements and be included with the shop submittal drawings. **See Supplementary and Special Conditions, Paragraph 15-6.**

5F-05. **STRUCTURAL DESIGN:**

The manufacturer shall furnish engineering calculations as part of the shop drawings submittal of the building, for the prefabricated structure, prepared by an engineer licensed in the State of Florida. The design shall be based on accepted engineering principles using accepted values of

safety factors. Values of connections and any details not subjected to rational analysis shall be substantiated by reference to a nationally accepted standard or test. The building shall be designed to be following the Florida Building Code 2023. Certification will be required to this effect by the manufacturer and this certification shall be included as part of the bidding documents.

The bidding documents components will be designed to meet the most severe conditions produced by the following load combinations:

- A. Building dead load, plus roof live load.
- B. Building dead load, plus wind load.

Design wind load shall be 131 mph as per ASCE 7-10.

Building manufacturer shall submit all design criteria for approval by the Architect prior to prefabrication of the building.

5F-06. BASIC MATERIAL SPECIFICATIONS:

A. Primary Framing Steel:

- 1. Steel for hot rolled structural sections conform to requirements of ASTM Specification A-36.
- 2. Steel for all built-up sections shall conform to modified ASTM Specifications A-36, the modification being a minimum yield point of 42,000 PSI.

B. Secondary Framing Steel: Steel used to form purlins, girts, eave struts and "C" sections shall be flat steel stock having a minimum yield point of 55,000PSI.

C. Roofing Covering: Shall be exposed metal panel type with a factory applied protective coating. The interlocking standing seam steel roof panels shall be noncombustible, Class One panels, color to be selected.

D. Wall Covering: Shall be of metal curtain -wall type with a factory applied protective coating. The interlocking ribbed steel wall panels shall be noncombustible Class One panels, color wall panels to be selected from metal color samples.

5F-07. STRUCTURAL FRAMING:

A. General:

- 1. All framing members shall be shop fabricated for bolted field assembly. The surfaces of the bolted connections shall be smooth and free from burrs or distortions.
- 2. All shop connections shall be in accordance with the American Welding Society Code for Building Construction. Certification of welder qualifications will be

furnished when required and specified.

3. All framing members, where necessary, shall carry an easily visible identifying mark.

B. Primary Framing:

1. Rigid Framing: All rigid frames shall be welded, built-up "T" sections. The columns and the rafters may be either uniform depth or tapered.
2. Plates, Stiffeners, etc.: All base plates, splice plates, cap plates, and stiffeners shall be factory welded into place on the structural members.
3. Bolt Holes, etc.: All base plates, splice plates, and flanges shall be shop fabricated to include brace rod holes and flange brace holes.

C. Secondary Framing:

1. Purlins and Girts: Purlins and girts shall be cold roll-formed "Z" sections with stiffened edges. They shall be pre-punched at the factory to provide for field bolting to the rigid frames. They shall be simple or continuous span as required by design.
2. Eave Struts: Eave struts shall be unequal flange cold formed "C" sections.
3. Base Angle: A continuous member will be supplied to which the base of the wall covering may be attached to the perimeter of the slab. This member shall be secured to the concrete slab with ramsets, expansion bolts, or anchor bolts as shown on the drawings.

D. Bracing:

1. Rod Bracing: Diagonal rod bracing in the roof and side walls shall be used to remove longitudinal loads (wind, crane, etc.) from the structure. These rods will be furnished to length, threaded, and equipped with level washers and nuts at each end.
2. Flange Braces: The compression flange of all primary framing shall be braced laterally with angles connecting to the webs of purlins or girts so that the compressive stress is within allowable limits for any combination of loadings.
3. Special Bracing: When diagonal rod bracing is not permitted in the sidewalls, a rigid frame type portal must be placed between the frames. Wind bracing in the roof and / or walls need not be furnished when it can be shown that the diaphragm strength of the roof and / or wall covering is adequate to resist the applied wind forces.

5F-08. ROOF PANELS:

See Section 7 of these specifications for Metal Roofing specifications.

5F-09. WALL PANELS:

Metal wall panels shall be equal to Butler Rib II Exterior Metal Wall System as manufactured by Butler Manufacturing and shall be in accordance with AISI North American Specification for the design of cold formed steel structural members. Wall panels shall be roll-formed, 36" wide with four (4) major corrugations 1 ½" high (deep) 12" o.c., with two (2) minor corrugations between each of the major corrugations and all shall be the entire length of the panel. Wall panels shall have factory punched openings at ends and in field for proper alignment at base, girts, and eaves. Wall panels shall be 24 gauge painted galvalume aluminum zinc alloy (55% aluminum, 45% zinc) in accordance with ASTM-A-792. Fasteners shall be Rox-head self-drilling screws, factory painted to match wall panel color.

Wall panels shall be supplied in continuous lengths from the building base to either the eave or rake height with no horizontal joints except over and/ or under door and window openings and where a wall splice is required for necessary weather tight flashing of attached structures.

All panels shall be of coated steel tested in accordance with ASTM Designation A-446 Grade B to meet or exceed a minimum yield point of 37,000 psi. protective coating shall be as hereinafter specified.

Color of wall panels to be selected from metal samples.

All walls shall be properly flashed and /or caulked at the base, eave, and rake.

5F-10. FINISHES:

- A. Wall Panels: Finish with corrosion - resistant metallic coating, Kynar 500, 1 mil (.001") thick, factory applied prior to fabrication. Color to match existing roof panels on adjacent Main Building.
- B. Roof Panels: Roof panels will have galvanized 1 mil thick factory applied.
- C. Samples of roof and wall panel colors to be submitted for color selection.

5F-11. FASTENINGS:

All fastenings shall be of the type, length and spacing that will secure the framing and support members directly into the existing and / or new structural system and as recommended by the metal building panel manufacturer. Fastenings shall be of stainless steel.

The contractor shall submit to the Architect prior to starting any work, a complete list of the fastenings he proposes to use for each framing system, showing by size, type, and spacing, etc.

5F-12. ROOF AND WALL INSULATION:

Where shown on the drawings, insulation installed over framing supports, and underside of metal roof and inside of wall panels, insulation shall be white vinyl faced, metal building

insulation .6 pcf density, 4' wide blanket, below roof panels providing 6" thick insulation with R=19 and at wall panels provide 3" insulation R=10. Installation shall be so that complete underside of roof and wall panels are completely covered, and a complete vapor barrier is formed. The combined assembly of insulation and roof panels must carry a flame spread rating of no greater than 25.

5F-13. MISCELLANEOUS:

- A. Ridge Vent: Where shown, furnish and install continuous gravity type ridge vent as detailed. Sheet metal parts shall be of 22 gauge. Finish and color to be same as roof panels.
- B. Drip and Trim Pieces: To be in shapes, sizes and gauges as shown on the drawings. All metal for trim pieces to be minimum 24 gauge, in same finish and color as fascia panels and wall panels. Where galvalume finish is called for, drip and trim gutter and downspout to be painted color as selected by Architect. Drip shall be installed as detailed with continuous cleat and joints shall be butted and 4" wide joint covers installed overusing same material, gauge, finish, etc.
- C. Curbs: This contractor is to furnish and install all roof curbs that are required for Mechanical roof mounted exhaust fans air intake hoods, and gravity vents that penetrate this metal roof. Fan and air intake hood dimensions will be provided by the mechanical contractor. Gravity vents will be furnished by the General Contractor.

5F-14. GUTTERS AND DOWNSPOUTS:

- A. Where shown on the drawings, furnish and install gutters and downspouts. Gutters and downspouts will be constructed in rectangular shapes and sizes as determined by P.E.M.B. of 24-gauge galvanized iron. Finish shall be Kynar 500 finish in the same color as the fascia and wall panels.
- B. Downspout Adapters: Where downspouts shown tied directly into drainage system, site contractor shall furnish and install PVC adapters for transition directly into drainage system.
- C. All workmanship shall be first class. Gutters and downspouts shall be straight and true, and all components shall be properly anchored.

5F-15. DESIGN REQUIREMENTS:

Design for the pre-engineered building, metal roofing and fascia system shall be designed to resist a wind uplift of 131 mph as per ASCE 7-10.

Panel assembly to bear Underwriters Laboratory Label UL90.

As noted above, Shop drawings for metal roofing and sidewall system shall be signed and sealed by a professional engineer licensed in the State of Florida.

5F-16. GUARANTEES:

The following guarantees shall be furnished to the Owner at completion of project, dated the Date of Acceptance, for each Metal Roof System.

- A. Manufacturer's Warranty: Warranting the finish of the panels against blistering, peeling, cracking, or chipping and against significant color change, for a period of Twenty (20 yrs.) Years.
- B. Manufacturer's Twenty (20 yr.) Year Warranty: For weather tightness of the total metal roofing system.

If not implied or stated on this Warranty, the Roofing Contractor shall furnish separate Guarantee in writing, to the Owner, his Workmanship and Materials Guarantee, guaranteeing the weather tightness of his work for a period of two (2) years, from Date of Acceptance.

5F-17. PAINTING:

- A. Primary structural members shall be factory painted with P.E.M.B. System manufactured standard primer with surface preparation executed in accordance with P.E.M.B. System manufacturer's standard process. Any scratches, blemishes, rust, or other imperfections caused during fabrication, shipping, or erection shall be repainted using same factory primer in color to match.
- B. C & Z purlins and girt members shall be factory primed / painted standard factory applied red oxide primer coat.

5F-18. EXTERIOR COMPONENTS OF BUILDING ENVELOPE:

See related sections in these specifications for exterior, roll up doors, personnel doors, hollow metal frames, window glass and frames, store front and other finishes as noted and / or shown.

END OF SECTION

SECTION 5H
ALUMINUM WALKWAY CANOPY SYSTEM

5H-01. ALUMINUM WALKWAY CANOPY SYSTEM:

- A. A new walkway canopy system will be furnished and installed as shown on the drawings.
- B. Furnish and install aluminum canopy external walkway system where shown on the drawing equal to cover system as manufactured by Royal Aluminum, Inc. P. O. Box 895008, Leesburg, Florida 34789, (800-342-3622) or equal to system manufactured by Lawrence Commercial Systems, 418 Audubon Drive, Tallahassee, Florida 32312, (850-574-8723, FAX 850-576-8112) or equal to Peachtree Protective Covers, Inc., 1477 Rosedale Drive, Hiram, Ga. 30141, (770-739-2120, FAX 770-439-2122, 800-341-3325) or Perfection Architectural Systems, Inc., 2310 Mercator Drive, Orlando, FL 32807, (1-800-238-7207, FAX 407-671-8252).
- C. Materials: All sections described below shall be sized and furnished with the required gauge to comply with wind loading and structural conditions for the width and height for the covered walkway shown at each of the school sites.
1. Aluminum extrusions shall be 6063 alloy, heat-treated to a T-6 temper.
 2. All fasteners and hardware shall be aluminum or stainless steel.
 3. Roof Deck: Load bearing roof deck shall be 3 inches deep extruded caps and pans and shall be properly supported by the primary framing members. Roof deck shall be "roll-locked" using interlocking joints designed and fabricated to provide structural continuity and self-flashing. Gauge shall be 0.032 inches or greater to meet required design loads.
- D. Gutter: Gutter shall consist of extruded aluminum having the cross section shown on the drawings. Gutter shall have a 0.110-inch minimum wall thickness and a 5-inch minimum throat width to facilitate cleaning by hand. Corners shall be shop fabricated with welded miter joints. Internal gutter splices shall be fastened using aluminum rivet pattern as shown in drawings.
1. End Closer shall consist of extruded aluminum 0.150 inches thick. Corners shall be shop fabricated with welded miter joints. Closer shall be fastened using aluminum or stainless-steel screws.
 2. Posts: Posts shall consist of four inches or larger 0.150-inch-thick extruded aluminum as required to meet design loads.
 3. Beams: When required, beams shall be extruded aluminum tubes four inches or larger in cross section with a minimum wall thickness of 0.125 inches as required to meet design loads.
 4. Finish: Finish on all roof deck, posts, beams, and gutters shall be bright silver baked enamel.
- E. Installation:
1. System shall be installed by firm who has had not less than five years' experience in the insulation of this same type of manufactured systems.

2. Erection shall be scheduled after all adjacent construction has been completed.
3. Posts spacing per shop drawings. When applicable, column interiors shall be filled with grout to the lowest edge of the “drain hole”, and the grout sloped to drain prior to the installation of the deflector plates.
4. Miter and “butt-cut” joints exhibiting evidence of poor workmanship will be removed and replaced at no additional cost to the Owner.
5. Walkway cover shall have drainage from deck to structural gutter and shall convey water to grade using post as downspout, with internal diverters to direct collected storm water away from sidewalk.

F. Delivery, Storage and Handling:

1. Products shall be shop fabricated to the greatest extent possible.
2. All materials shall be protected from weather and installation damage continuously during both storage and erection.
3. Handling shall be done in a manner to prevent damage. All damaged areas shall be repaired to match the original.

G. Shop Drawings:

1. Submit shop drawings signed and sealed by a Professional Engineer registered in the State of Florida, stating that the walkway canopy system meets all requirements to resist an ultimate wind speed of 131 m.p.h. as per FBC 2010, and an exposure category Zone C as per structural drawings.

Drawing submittals shall contain the following:

List of Applicable Codes
Design Loadings
Dimension Layout Plan
Walkway Cover Sections
Connection and Splice Details
Foundation Details

2. Manufacture’s Data: Data shall be provided indicating that all materials meet or exceed the specified requirements.
3. Samples: Submit complete sets of samples illustrating materials to be expected in the completed work.

H. Cleaning:

1. All discarded materials, rubbish and debris resulting from the work of this section shall be removed from site. Upon completion of the work, all surfaces which become soiled or coated will be cleaned using methods which will not scratch or otherwise damage finish surfaces.

2. Protect against damage until final acceptance. Replace or repair any such damaged work to the satisfaction of the Architect.
 3. Touch up minor scratches and abrasion.
- I. Warranty: Submit standard 1-year warranty including materials and labor on walkway cover system with Owner's name listed as warrantee and beginning date of warranty period corresponding to Date of Substantial Completion.

END OF SECTION

SECTION 6A

CARPENTRY, MILLWORK, AND INSULATION

6A-01. GENERAL CONDITIONS:

The General and Special Conditions, Division II, Sections E and F of these specifications shall apply to and form a part of this Section as if written in full herein.

6A-02. SCOPE:

The contractor shall furnish all labor and materials for carpentry, millwork and case work as indicated on drawings or specified, or reasonably required to finish the work. Work under this heading shall be properly coordinated with all other trades. The carpenter shall do all cutting and fitting for carpentry and millwork and render all such other assistance required for other branches of the work, making good after other mechanics.

6A-03. LUMBER, IN GENERAL:

All lumber shall be thoroughly seasoned and dried to a moisture content of not over 10% for framing lumber and not over 12% for millwork, and when delivered shall be stored and protected to keep same dry.

All lumber for any purpose shall be dressed four (4) sides, unless otherwise noted and be free from holes, large loose knots, bark and large pitch streaks, regardless of grade.

Grading shall be according to grading rules of the Southern Pine Inspection Bureau under which it is manufactured and each piece of bundle, if bundled stock, shall bear an Inspection Bureau's mark, indicating the grade.

Doors, trim, and millwork in general shall not be stored in the building while the building is damp or in any damp storage location.

6A-04. LUMBER GRADES:

All trim shall be No. 1 Fir. All blocking "cant" strips, grounds or nailers shall be pressure treated No. 2 grade, Yellow Pine; wood studs and wood joists shall be Fir or Yellow Pine structural grade.

6A-05. TREATED LUMBER:

- A. Structural Lumber: Give all nailers, blocking and wood grounds in contact with exterior masonry, concrete, roof slabs or steel, pressure preventative treatment in closed retort as per FS TT-W-571; minimum net preservatives as specified herein. Any of the following preservatives will be acceptable:

<u>Preservative</u>	<u>Lbs. Per Cu. Ft.</u>
Pentachlorophenol (5% solution in oil)	Solution 6.0
Zinc Chloride	Dry Salt 1.0
Zinc Metal Arsenite (ZMA)	Dry Salt .03
Wolman Salts (Tanalith)	Dry Salt 0.3
Chromated Zinc Chloride	Dry Salt 0.75

After using the salt treatment, reduce lumber moisture content to not over 10%. Brush coat surfaces of lumber sawed, bored or cut, after treatment with same preservative used at plant. Accompany lumber with certificates from lumber treatment company, certifying treatment amount, moisture percentage after kiln drying. Architect reserves the right to apply method for determining penetrating as per manual issued by the American Wood Preserver's Association. Treatment shall be arsenic free.

6A-06. METAL GLASS STOPS:

All wood doors shown or noted with glass lights shall have metal stops. Stops shall be Type FGS75 for single glazing and shall be as manufactured by Anemostat Door Products. **Install stops with stainless steel through bolts.**

6A-07. MILLWORK:

Millwork shall be of material and manufacturer hereinafter specified and as indicated on the drawings and shown on details. In all cases millwork shall be of good standard construction. All joints shall be made in approved manner perfectly fitted. Secure with finishing nails with heads set for putty, and with screws and glue where required. All surfaces sanded smooth.

All trim and moldings shall be mitered at joints and corners and in full lengths within the limits of the material.

No sheet plywood shall be less than 1/4" thick, exposed surfaces, Grade A. Frames shall be primed on all sides at the mill with clear primer.

6A-08. TRIM:

Trim shall be as indicated on drawings or if not noted shall match specie of doors, siding, and paneling used. All other trim shall be as specified above, No. 1 Fir. All cuts in trim shall be painted with clear Rez during erection. All trim work including bonding on cabinets and cabinet work shall have mitered corners.

6A-09. PLASTIC LAMINATE:

Surfaces where detailed shall be standard grade plastic laminate, 1/16" thickness, furniture finish, color as selected. Edges are to be covered with laminate. Counter top sheet shall overlap counter edge and corners ground to a 45-degree angle. Laminate shall be Formica, Micarta, Wilson Art, or equal. Colors shall be of solid colors as selected. **Other than manufactured casework items, all millwork, window sills, and other surfaces shown with plastic laminate, plastic laminate shall be field applied.**

6A-10. ROUGH HARDWARE:

The contractor shall furnish all nails, screws, bolts and fittings required to fabricate and install his work in place of the character required and best suited to the conditions of the work.

6A-11. APPLICATION OF FINISH HARDWARE:

Finish hardware is specified under another Section. Fit and apply all finish hardware to wood doors and leave same in operating order. All mortises, sinkages and cuts shall be accurately made to fit or be covered by hardware. Screws shall be counter sunk or counter bored and plugged as specified. All screws shall be screwed in place and not hammered. (After the finish hardware has been fitted, remove same until the painter has applied the last coat of paint on every surface, then reset in place.) See Carpet Section and Finish Hardware Section for aluminum saddles at doors between corridors and rooms.

6A-12. DOOR LOUVERS:

All door louvers to be furnished by others and installed by this Contractor.

6A-13. CAULKING:

Where backsplashes and/or counter tops finish against plastic walls, the joint shall be caulked with a Thiokol caulking compound before painting.

6A-14. PLYWOOD:

All plywood shall have markings stamped on sheets for grades and thicknesses called for. When used for exterior applications, plywood is to be exterior grade with exterior glue.

6A-15. SPRAY FOAM ROOF DECK INSULATION:

- A. Scope: Furnish and install low-density open cell spray foam insulation at the bottom of the new metal roof deck panels as shown on the drawings.
- B. Product Description: Icynene LD-C-50, low density, two component, open cell,

polyurethane foam plastic insulation, and air barrier, which is 100% water blown. The two components of the spray-applied product are polymeric isocyanate and a proprietary resin.

C. Product Characteristics:

1.	Normal Density	.5pcf
2.	Surface Burning	Flame spread index of less than 25 in accordance with ASTM E 84 / UL 723 Smoke development index of less than 450 in accordance with ASTM E 84 / UL 723
3.	Thermal Resistance	R value equal to 3.7 / inch thickness
4.	Air Permeability	At minimum thickness of 3 1/2", is considered air impermeable in accordance with ASTM E 283

D. Application: Apply and install Icynene LD-C-50 in strict accordance with all published manufacturer's installation instructions. Icynene LD-C-50 must be applied using spray equipment specified and approved by Icynene Inc. The insulation can be installed one pass to the maximum thickness. Where multiple passes are required, cure time in between passes is negligible.

6A-16. EXTERIOR WALL INSULATION: As indicated in Section 5F-12.

6A-17. INTERIOR WALL SOUND BATTS:

Install interior wall sound batts at interior metal stud framed wall construction as shown in drawings equal to un-faced sound attenuation batts fiber glass as manufactured by Owens Corning with the following characteristics:

Thickness: 3 1/2" Width: 16" Length: 96"

Surface Burning Characteristics / Rating: Flame Spread Rating 10
 Smoke Developed Rating 10

Acoustical Performances: N.R.C. (Noise Reduction Coefficient) 1

Thermal Performance: R-Value 11

6A-18. INTERIOR CEILING SOUND BATTS: N.A.

6A-19. CLEAN-UP:

The Contractor shall remove all debris, scrap, etc., from the site upon completion of his work. Tile shall be free of fingerprints, smudges, and present a uniform color, clean and level. Any tile found to contain smudges, chips, etc., shall be removed and replaced with new tile.

6A-20. GUARANTEE:

This contractor shall guarantee in writing the materials and workmanship for a period of two (2) years after final acceptance of the building.

END OF SECTION.

SECTION 7A

METAL ROOF PANELS

7A-01. **GENERAL CONDITIONS:**

The General and Special Conditions, Division II, Sections E and F of these specifications shall apply to the form part of this Section as if written in full herein.

7A-02. **SCOPE OF WORK**

- A. Furnish all labor, material, equipment, and incidentals necessary for installing all new roofing and fascia panels, including required trim, flashing, framing and supports for new metal roofing and fascia panels, and other related items as indicated on the drawings and as specified, and/or as required to complete the work.

The roofing system will consist of installing a standing seam 24-gauge metal panel roofing over a loadmaster or light gauge framing system as shown on the drawings for each of the three buildings.

7A-03. **INCIDENTAL WORK:**

All work which is incidental to the installation of the roof and fascia shall be done by this Contractor. This includes flashing, trim, gutter and downspouts and any other items related to the above roofing areas, fastening and any support work required to complete the installation.

7A-04. **METAL ROOF PANELS:**

- A. **Manufacturers:** Metal roofing shall be one of the manufacturers listed below. Panels from other manufacturers will be acceptable providing they conform to the same shape, size, gauge, method of fastening and type of finish. **Contractors proposing to use roof panels other than as specified shall submit sample panel showing fastening system and panel specifications prior to receipt of bids for approval.** (See Section B, paragraph B-5, Substitutions, these Specifications)

All roof panels as listed below, shall be flat panels and shall be 16" wide and have a 2" high standing seam and of 24-gauge galvanized steel. All roofing materials shall be labeled Class "A" per ASTM 108 and shall be certified by a nationally recognized independent testing laboratory. All roofing systems shall be installed within the limitations of the test procedure for surfaces, deck cross slope and combustibility.

Insulation, moisture protection, roofing, thermal requirements, fireproofing, and fire stopping shall be designed and constructed in compliance with the Florida Building Code and the Florida Fire Prevention Code as adopted by the State Fire Marshall.

All newly installed materials shall be protected from moisture and sealed for moisture protection

at the end of each day. The contractor shall provide the Architect / Engineer of record a final statement of compliance for the Board.

B. Acceptable Manufacturers:

1. VSR Roof System, Butler Standing Seam, 16" wide, 2" high seam, Butler Manufacturing Company.
2. American Loc-Seam Panel, 16" wide, 2" high seam, American Buildings Company.
3. Berridge Zee-Lock Panel, 16" wide, 2" high seam, Berridge Manufacturing Co.
4. M and M Series 300 Style 316.
5. ARS, Architectural Roof Systems, 16" wide, 2" high seam.
6. Englert KR 24 Panel, 16" wide, 2" high 90° seam, Englert, Inc.
7. Battenlok 16" wide x 2" high rib panels as manufactured by MBCI Metal Roofing and Wall Systems.

C. Roof Panels:

1. Roof panels shall be a manufactured non-embossed structural, 24-gauge panel of 50,000 psi minimum yield steel, with a material Galvalume coating, conforming to ASTM A792. Panels shall be 16" wide and have a minimum of 2" deep male and female rib. All panels shall be a mechanically seamed rib panel.

All panels shall be full lengths from ridge to top of fascia as detailed. End splices will not be acceptable on any of the portions to be roofed. Furnish with end inserts to close batten void at end of panel and C closer at top of panels.

2. Fastening of roof panels to support framing shall be by a concealed fastener system, so no screws penetrate the face of the roofing panel nor are any screws visible. Where shown on the drawings, thermal spacers shall be installed between the insulation and bottom face of the panel to provide a positive thermal break between the roof panels and supporting members.

Concealed Z clip shall be a minimum 2" long, 3" high of not less than 24-gauge aluminized steel (min. yield 48,000 psi).

3. Sealant shall be either factory or field applied in longitudinal female rib of all panels regardless of roof panel manufacturer. Sealant shall be an extrudable non-drying, non-skidding synthetic elastomer material.
4. Finish: Exterior finish of roof and fascia panels and trim pieces for the metal roofing system shall be a fluoropolymer Kynar 500 coating, minimum of 1 mil nominal thickness. The Architect will select color.

D. Roof Panel Penetrations:

1. Plumbing vents and stacks shall be extended through new metal roofing panels and flashed with new EPDM flashing to make for watertight installation.
2. Flashing for exhaust fan curbs and for any penetrations shall be as per manufacturer's details for flashing.

E. Sealants:

1. Closer Strips: The corrugations of the roof and wall panels shall be filled with solid or closed cell, preformed, rubber or neoprene closures along with eave ridge and rake when required for weather-tightness.
2. Sealer: All roof panels side laps and end laps shall be sealed with 3/16" diameter mastic. The sealer shall be a gray elastic compound of synthetic base and fibrous filler and shall have good adhesion to metal. The material shall be non-staining, non-corrosive, non-shrinking, non-oxidizing, non-toxic and non-volatile. The service temperature will be from -30° F to -200° F and the flash point must be above 400° F. The material shall meet or surpass the requirements of Specification Mil-C-18969B, Type II, Class B, and shall be equal to that manufactured by Presstite Division of Interchemical Corporation.
3. Gutter Sealer: All gutter joints shall be sealed with aluminum pigmented 3M Gutter Seal or equal.

F. Fascia Panel Installation: N.A.

7A-05. FINISHES:

- A. Roof Panels: Finish shall be a 24-gauge steel coated both sides with a layer of galvalume aluminum zinc alloy (approximately 55% aluminum & 45% zinc) applied by the continuous hot dip method. Minimum .055-ounce coated weight per square foot as determined by the triple spot test per A.S.T. M. specifications A-792.
- B. Samples of roof and wall panel colors to be submitted for color selection.

7A-06. FASTENINGS:

All fastenings shall be of the type, length and spacing that will secure the framing and support members directly into the existing and/or new structural system and as recommended by the metal building panel manufacturer. **Fastenings shall be of stainless steel.**

The contractor shall submit to the Architect prior to starting any work, a complete list of the fastenings he proposes to use for each framing system, showing by size, type, and spacing, etc. joist structural system. Metal roof panels applied over this system shall have fasteners penetrating either the steel joist or through the heavy-duty steel decking. See roof deck systems section, these specifications, for deck system.

7A-07. MISCELLANEOUS:

- A. Ridge Vent: Where shown, furnish and install continuous gravity type ridge vent as detailed. Sheet metal parts shall be of 22 gauge. Finish and color to be same as roof panels.

- B. Drip and Trim Pieces: To be in shapes, sizes and gauges as shown on the drawings. All metal for trim pieces to be minimum 24 gauge, in same finish and color as roof panels where panels are called for with color finish. Where galvalume finish is called for, drip and trim gutter and downspout to be painted color as selected by Architect. Drip shall be installed as detailed with continuous cleat and joints shall be butted and 4" wide joint covers installed overusing same material, gauge, finish, etc.
- C. Curbs: This contractor is to furnish and install all roof curbs that are required for Mechanical roof mounted exhaust fans air intake hoods, and gravity vents that penetrate this metal roof. Fan and air intake hood dimensions will be provided by the mechanical contractor. Gravity vents will be furnished by the general contractor.

7A-08. GUTTERS AND DOWNSPOUTS:

- A. Where shown on the drawings, furnish and install gutters and downspouts. Gutters and downspouts will be constructed in shapes and sizes as detailed and of 24-gauge steel. Finish shall be Kynar 500 finish in color selection from PEMB System manufacturer's standard colors.
- B. Downspouts terminate will terminate into a downspout elbow diverter as required to divert roof water away from building.
- C. All workmanship shall be first class. Gutters and downspouts shall be straight and true, and all components shall be properly anchored.
- D. Anchorage for downspouts to building wall shall be as shown and detailed on the drawings.

7A-09. UNDERLAYMENT: N.A.

7A-10. METAL CORRUGATED SIDING PANELS: N.A.

7A-11. DESIGN REQUIREMENTS:

Design for the metal roofing system, metal soffit system and corrugated metal siding panels shall be for an ultimate wind speed of 131 mph as per ASCE 7-10 and the State of Florida Building Code 2023.

Shop drawings shall be signed, dated, and sealed by a Florida Registered Engineer, and it shall be stated by the Engineer that the system will comply with the uplift requirements as state herein.

Metal roofing and fascia system shall contain product approval numbers and information showing product complies with the Florida Building Code 2023, Section 17. See Supplementary and Special Conditions, Paragraph 15-6

7A-12. GUARANTEES AND ONE YEAR INSPECTION:

A. The following guarantees shall be furnished to the Owner at completion of project, dated the Date of Acceptance, for each Metal Roof System.

1. Manufacturer's Warranty: Warranting the finish of the panels against blistering, peeling, cracking, or chipping and against significant color change, for a period of Twenty (20-Yrs.) Years.
2. Manufacturer's Twenty (20 Yr.) Year Warranty: For weather tightness of the total metal roofing system, both classroom building and pavilion.

If not implied or stated on this Warranty, the Roofing Contractor shall furnish separate Guarantee in writing, to the Owner, his Workmanship and Materials Guarantee, guaranteeing the weather tightness of his work for a period of three (3) years, from Date of Acceptance.

B. Manufacturer's One Year Inspection: The roof shall be inspected by the manufacturer's representative within one year of the project's completion and acceptance of the Board.

END OF SECTION

SECTION 8A

GLASS, GLAZING, AND STOREFRONT

8A-01. **GENERAL CONDITIONS:**

The General and Special Conditions, Division II, Sections E and F of these specifications shall apply to and form a part of this Section as if written in full herein.

8A-02. **SCOPE:**

Furnish all labor, materials, and equipment and perform all operations necessary for the complete installation of all glass, glazing, windows, and store front as noted in these specifications and as shown on the drawings.

8A-03. **GLAZING:**

All glazing shall be done by experienced glaziers. Only high-grade glazing compound shall be used. G.E. Silglaze 2400 Silicone Sealant. All surfaces to be glazed shall be clean and dry and no glazing shall be done in freezing weather. Face putty shall be smooth and of uniform width, without ripples and all corners shall be cut clean and sharp.

Rebates of glazed panels and doors shall be primed before installing glass and all glass shall be back puttied and bedded on all sides except as noted for plate glass. Heat absorbing glass shall be set as to allow free expansion and contraction of the material.

Each piece of glass shall bear the manufacturer's label of quality and the labels shall remain in place until after inspection and approval of Architect. After inspection and approval, the labels shall be removed and glass cleaned and polished, both sides.

8A-04. **SAFETY STANDARDS:**

All glazing shall comply with Safety Standards for Architectural Glazing 16CFR as issued by the Consumer Safety Commission. **All windows shall meet requirements for 131 mph ultimate wind speed as per the 2023 Florida Building Code and ASCE 7-10.**

8A-05. **NON-SECURITY LEVEL GLASS:**

PART 1 -GENERAL

1.1 SECTION INCLUDES

- A. Glass and glazing units for the following products and applications, and glazing requirements referenced by other sections:
 - 1. Windows.
 - 2. Doors.

3. Interior borrowed lites.
4. Glazed entrances.
5. Storefront framing.
6. Glazed curtain walls.
7. Skylights.

B. Glazing accessories.

1.2 RELATED SECTIONS

- A. Division 08 Section 'Decorative Glass Glazing.'
- B. Division 08 Section 'Mirrors.'
- C. Division 08 Section 'Plastic Glazing.'
- D. Division 08 Section 'Security Glazing.'

1.3 REFERENCES

- A. American Architectural Manufacturers Association:
 1. AAMA 800 - Voluntary Specifications and Test Methods for Sealants.
- B. ASTM International (ASTM):
 1. **ASTM C 509** - Specification for Elastomeric Cellular Preformed Gasket and Sealing Material.
 2. **ASTM C 864** - Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
 3. **ASTM C 920** - Specification for Elastomeric Joint Sealants.
 4. **ASTM C 1036** - Specification for Flat Glass.
 5. **ASTM C 1048** - Specification for Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass.
 6. **ASTM C 1087** - Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems.
 7. **ASTM C 1115** - Specification for Dense Elastomeric Silicone Rubber Gaskets and Accessories.
 8. **ASTM C 1172** - Specification for Laminated Architectural Flat Glass.
 9. **ASTM C 1281** - Specification for Preformed Tape Sealants for Glazing Applications.
 10. **ASTM C 1330** - Specification for Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
 11. **ASTM C 1376** - Specification for Pyrolytic and Vacuum Deposition Coatings on Glass.
 12. **ASTM E 774** - Specification for the Classification of the Durability of Sealed Insulating Glass Units.
 13. **ASTM E 1300** - Practice for Determining Load Resistance of Glass in Buildings.
 14. **ASTM E 2190** - Standard Specification for Insulating Glass Unit Performance and Evaluation.
- C. Code of Federal Regulations:
 1. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials.
- D. Glass Association of North America (GANA):
 1. Glazing Manual.
 2. Laminated Glass Design Guide.

3. Engineering Standards Manual.
- E. The Insulating Glass Manufacturers Alliance (IGMA):
 1. IGMA TB-3001 - Sloped Glazing Guidelines.
 2. IGMA TM-3000 - Glazing Guidelines for Sealed Insulating Glass Units.
- F. Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; Building Technologies Department; Windows & Daylighting Group,
windows.lbl.gov/software:
 1. **"LBNL Window 5.0 (or higher) - A PC Program for Analyzing Window Thermal and Optical Performance.**
- G. National Fenestration Rating Council (NFRC):
 1. NFRC 100 - Procedure for Determining Fenestration Product Thermal Properties.
 2. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficients at Normal Incidence.
 3. NFRC 300 - Procedures for Determining Solar Optical Properties of Simple Fenestration Products.
- H. National Fire Protection Association (NFPA):
 1. NFPA 80 - Fire Doors and Windows.
 2. NFPA 252 - Fire Tests of Door Assemblies.
 3. NFPA 257 - Fire Test for Window and Glass Block Assemblies.

1.4 DEFINITIONS

- A. Manufacturers of Primary Glass: Firms that produce primary glass, as defined in referenced industry publications.
- B. Manufacturers/Fabricators of Glass Products: Firms that utilize primary glass in the production of glass products that may include coated glass, laminated glass, and insulating glass.
- C. Sealed Insulating Glass Unit Surfaces:
 1. Surface 1: Exterior surface of outer lite.
 2. Surface 2: Interspace-facing surface of outer lite.
 3. Surface 3: Interspace-facing surface of inner lite.
 4. Surface 4: Interior surface of inner lite.

1.5 PERFORMANCE REQUIREMENTS

- A. General: Provide glazing systems that will withstand indicated loads and normal thermal movement without failure, including loss or glass breakage resulting from defective manufacture, fabrication, or installation; failure of glazing systems to remain watertight and airtight; or deterioration of glazing materials.
- B. Glass Design: Glass thicknesses indicated are minimums. Select actual glass lite thicknesses by analyzing loads and conditions. Provide glass lites in the thicknesses and in strengths required to meet or exceed the following criteria:
 1. Glass Thicknesses: Comply with ASTM E 1300, as follows:
 - a. Specified Design Wind Loads: As indicated.
 - b. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set within 15 degrees of vertical and under wind load for a load duration of [3] seconds.

- c. Probability of Breakage for Sloped Glazing: 1 lite per 1000 for lites set more than 15 degrees off vertical and under wind and snow loads for a duration of [30] days.
 - d. Thickness of Tinted Glass: Provide the same thickness for each tint color for all applications.
- C. Thermal Movements: Allow for thermal movements of glazing components and glass framing members resulting from a temperature change range of 120 deg F ambient and 180 deg F material surfaces.
- D. Thermal and Optical Performance Properties: Provide glass meeting specified performance properties, based on manufacturer's published test data for units of thickness indicated, and the following:
- 1. Center-of-Glass Values: Per LBNL Window 5.0 (or higher) analysis, as follows:
 - a. U-Factors: NFRC 100 expressed as Btu/sq. ft. x h x deg F.
 - b. Solar Heat Gain Coefficient: NFRC 200.
 - c. Solar Optical Properties: NFRC 300.

1.6 SUBMITTALS

- A. Product Data: Manufacturer's data sheets for each glass product and glazing material.
- B. Samples: 12-inch-square, for each type of glass product, other than monolithic clear float glass [or clear float glass only set in insulated glass units].
- C. Glazing Schedule: Prepare schedule using designations used on Drawings.
- D. Product Certificates: Signed by manufacturers/fabricators of glass products certifying that products furnished comply with project requirements.
- E. Preconstruction Adhesion and Compatibility Test Report: From glazing sealant manufacturer, based on submitted samples or acceptable data from previous testing of current formulations with equivalent products.
- F. Qualification Information: For Installer firm and Installer's manufacturer/fabricator-trained field supervisor.
- G. Warranties: Submit sample meeting warranties requirements of this Section.

1.7 QUALITY ASSURANCE

- A. Manufacturer/Source: Obtain each type of glass product from a single primary glass manufacturer and a single manufacturer/fabricator for each glass product type.
 - 1. For glass sputter-coated with solar-control low-e coatings, obtain glass products in fabricated units from a manufacturer/fabricator certified by the primary glass manufacturer.
- B. Installer Qualifications: Experienced Installer with minimum of 5 successful completed projects of similar materials and scope, approved by glass product manufacturer/fabricator.
- C. Preconstruction Adhesion and Compatibility Testing: Submit glass units, glazing materials, and glass-framing members with applicable finish to elastomeric glazing sealant manufacturer for determination of sealant compatibility, priming, and preparation requirements for optimum adhesion and performance.

- D. Glazing for Fire-Rated Door and Window Assemblies: Glazing tested per NFPA 252 and NFPA 257, as applicable, for assemblies complying with NFPA 80 and listed and labeled per requirements of authorities having jurisdiction.
- E. Safety Glazing Products: Comply with size, glazing type, location, and testing requirements of 16 CFR 1201 for Category I and II glazing products, and requirements of authorities having jurisdiction.
- F. Glazing Industry Publications: Comply with glass product manufacturers' recommendations and the following:
 - 1. GANA Publications: GANA Laminated Division's 'Laminated Glass Design Guide' and GANA's 'Glazing Manual.'
 - 2. IGMA Publication for Insulating Glass: IGMA TM-3000, 'Glazing Guidelines for Sealed Insulating Glass Units.'
- G. Insulating-Glass Certification Program: Indicate compliance with requirements of Insulating Glass Certification Council on applicable glazing products.
- H. Mockups: Prior to installing glazing, build mockups to demonstrate materials and workmanship. Coordinate with mockup requirements of related sections.
- I. Preinstallation Conference: Conduct conference at Project site in compliance with Division 01 requirements.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials during shipping, handling, and storage to prevent breakage, scratching, damage to seals, or other visible damage. Deliver, unload, store, and erect glazing materials without exposing panels to damage from construction operations.
 - 1. Comply with manufacturer's venting and sealing recommendations for shipping and handling of insulating glass units exposed to substantial altitude change.

1.9 WARRANTY

- A. Warranty for Coated-Glass Products: Manufacturer's standard form, signed by coated-glass product primary manufacturer or manufacturer/fabricator, as applicable, agreeing to replace coated-glass units that display peeling, cracking, and other deterioration in metallic coating under normal use, within [10] years of date of Substantial Completion.
- B. Warranty for Laminated Glass: Manufacturer's standard form, signed by laminated-glass product manufacturer/fabricator, agreeing to replace laminated-glass units that display edge separation, delamination, and blemishes exceeding those allowed by ASTM C 1172, within [five] years of date of Substantial Completion.
- C. Warranty for Insulating Glass: Manufacturer's standard form, signed by insulating-glass product manufacturer/fabricator, agreeing to replace insulating-glass units that exhibit failure of hermetic seal under normal use evidenced by the obstruction of vision by dust, moisture, or film on interior surfaces of glass, within [10] years of date of Substantial Completion.
- D. Installer's Warranty: Form acceptable to Owner, signed by glass product Installer, agreeing to replace glass products that deteriorate, or that exhibit damage or deterioration of glass or glazing products due to faulty installation, within [2] years of date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Glass product selections are based upon the primary glass manufacturer below. Provide basis of design product [, or comparable product of a listed manufacturer approved by the Architect prior to bid]:
1. Vitro Architectural Glass, Cheswick, PA, (888) 774-4332, Email: ideascapes@ppg.com, <http://www.vitroglazings.com>.

2.2 GLASS PRODUCTS

- A. Annealed Float Glass, General: ASTM C 1036, Type I, Quality-Q3, class indicated.
- B. Annealed Ultra-Clear (Low Iron) Float Glass: Class I (clear).
1. Basis of Design Product: Vitro Architectural Glass, Starphire.
 2. [Specifier: insert manufacturer of comparable product if required]
- C. Heat-Treated Float Glass, Heat-Strengthened: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; Kind HS, of class and condition indicated: where indicated, where needed to resist thermal stresses and where required to comply with performance requirements.
- D. Heat-Treated Float Glass, Fully Tempered: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; Kind FT, of class and condition indicated: where safety glass is indicated. Safety glazing must comply with ANSI Z97.1 and CPSC 16CFR-1201
- E. Pyrolytic-Coated Float Glass: ASTM C 1376, float glass with metallic-oxide coating applied by pyrolytic deposition process during primary glass product manufacture.
- F. Sputter-Coated Float Glass: ASTM C 1376, float glass with metallic-oxide or -nitride coating deposited by vacuum deposition process following primary glass product manufacture.
- G. Ceramic-Coated Vision Glass: Float glass with silk-screened ceramic enamel application, per ASTM C 1048, Condition B, Type I, Quality-Q3, and Specification No. 95-1-31 in GANA 'Engineering Standards Manual.'
- H. Ceramic-Coated Spandrel Glass: ASTM C 1048, Condition B, Type I, Quality-Q3 and GANA 'Engineering Standards Manual' 66-9-20 Specification for Heat-Strengthened or Fully Tempered Ceramic Enameled Spandrel Glass for Use in Building Window/Curtain Walls and Other Architectural Applications.
- I. Coated Spandrel Float Glass: Float glass complying with ASTM C 1048, GANA 'Engineering Standards Manual' 89-1-6 Specification for Environmental Durability of Fully Tempered or Heat-Strengthened Spandrel Glass with Applied Opacifier and other requirements specified, with manufacturer's standard opacifier material on coated second surface of lites.
- J. Laminated Glass: ASTM C 1172, with manufacturer's standard polyvinyl butyral or cured resin interlayer.
- K. Insulating-Glass Units: Factory-assembled units consisting of dual-sealed lites of glass separated by a dehydrated interspace, with manufacturer's standard spacer material and construction, per ASTM E 2190.

2.3 GLAZING ACCESSORIES

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- B. Glazing Tape: Butyl-based elastomeric tape with integral resilient tube spacer, 10 to 15 Shore A durometer hardness, black color, coiled on release paper; widths required for specified installation, complying with ASTM C 1281 and AAMA 800 for application.
- C. Glazing Tape: Closed cell polyvinyl chloride foam, maximum water absorption by volume 2 percent, designed for 25 percent compression percent for air barrier and vapor retarder seal, black color, coiled on release paper over adhesive on two sides; widths required for specified installation, and complying with AAMA 800.
- D. Glazing Gaskets:
 - 1. Dense Compression Gaskets: ASTM C 864, neoprene or EPDM, or ASTM C 1115, silicone, or thermoplastic polyolefin rubber, as recommended by glazing product manufacturer for application, molded or extruded shape to fit glazing channel retaining slot; black color.
 - 2. Soft Compression Gaskets: ASTM C 509, Type II, black, molded, or extruded, neoprene, EPDM, silicone, or thermoplastic polyolefin rubber, of profile and hardness required to maintain watertight seal.
- E. Setting Blocks: ASTM C 864, neoprene, 80 to 90 Shore A durometer hardness; length 4 inches, width of glazing rabbet space less 1/16-inch, height required for glazing method, pane weight, and pane area.
- F. Spacer Shims: ASTM C 864, neoprene, 50 to 60 Shore A durometer hardness; length 3 inches, one half height of glazing stop, thickness required for application, one face self-adhesive.
- G. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- H. Glazing Sealants: ASTM C 920, type recommended by glazing product manufacturer for application indicated, complying with requirements of Division 07 Section 'Joint Sealants,' color as selected by Architect.
- I. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- J. Smoke Removal Unit Targets: Adhesive targets for application to glass, identifying glass units designed for removal for smoke control.

2.4 FABRICATION OF GLAZING UNITS, GENERAL

- A. Fabricate glazing units in dimensions required, with edge and face clearances, edge and surface conditions, and bite in accordance with glazing product manufacturer/fabricator's instructions and referenced glazing publications.

2.5 INSULATING-GLASS UNIT(S)

- A. Double Glazed Tinted Solar Control Insulating Glass Unit [Solarban® 60 on Solargray® 6mm (2) | Air 1/2" (12.7mm) | Clear 6mm]
1. Conformance: ASTM E 2190
 2. Outdoor Lite: Solargray® Tinted Float Glass as manufactured by Vitro Architectural Glass
 - a. Conformance: ASTM C 1036, Type 1, Class 2, Quality q3.
 - b. Glass Thickness: 6mm (1/4")
 - c. Magnetic Sputter Vacuum Deposition Coating (MSVD): ASTM C 1376.
 - d. Coating: Solarban® 60 on Surface # 2
 - e. Heat-Treatment: Heat-strengthened, ASTM C 1048, Kind HS.
 3. Interspace Content: Air 1/2" (12.7mm)
 4. Indoor Lite: Clear float glass as manufactured by Vitro Architectural Glass
 - a. Conformance: ASTM C 1036, Type 1, Class 1, Quality q3.
 - b. Heat-Treatment: Heat-strengthened, ASTM C 1048, Kind HS.
 - c. Glass Thickness: 6mm (1/4")
 5. Performance Requirements:
 - a. Visible Light Transmittance: 35 percent minimum.
 - b. Winter Nighttime U-Factor: 1.55 (W/m²*°C) maximum.
 - c. Summer daytime U-Factor: 1.55 (W/m²*°C) maximum.
 - d. Shading Coefficient: 0.29 maximum.
 - e. Solar Heat Gain Coefficient: 0.25 maximum.
 - f. Outdoor Visible Light Reflectance: 6 percent maximum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that glazing channels are clean and ready to accept glazing installation, and that weeps are unobstructed. Confirm that minimum required face and edge clearances will be maintained. Do not proceed with glazing until unsatisfactory conditions have been corrected.
- B. Examine glazing units prior to setting. Reject units that display edge or face damage that may impede performance of unit or that will be visible when installed.

3.2 PREPARATION

- A. Clean glazing channels with recommended solvent and wipe dry. Apply primers to joint surfaces to ensure adhesion of sealants, unless preconstruction sealant-substrate testing indicates no primer is required.

3.3 GLAZING INSTALLATION

- A. General: Install glass and glazing materials in accordance with instructions of manufacturers and requirements of GANA Glazing Manual.
1. Install setting blocks of size and in location required by glass manufacturer. Set blocks in bed of approved sealant.
 2. Provide spacers for glass lites as recommended, based upon size of glass unit.
 3. Comply with glass manufacturer's limits on edge pressures.

4. Ensure that glazing units are set with proper and consistent orientation of glass units toward interior and exterior.
 5. Provide edge blocking where recommended.
 6. Install sealants in accordance with requirements of Division 07 Section 'Joint Sealants.'
- B. Tape Glazing: Place tapes on fixed stops positioned to be flush or protrude slightly when compressed by glass. Install tapes continuously. Form butt joints at corners and where required, and seal tape joints with approved sealant.
1. Apply heel bead of glazing sealant along intersection of permanent stop and frame for continuity of air and vapor seal.
 2. Set glass lites centered in openings on setting blocks.
 3. Install removable stops, and insert dense compression gaskets at corners, working toward centers of lites, compressing glass against tape on fixed stops.
 4. Apply cap bead of elastomeric sealant over exposed edge of tape or gasket on exterior of glass unit.
- C. Sealant Glazing: Install continuous spacers between glass lites and glazing stops. Install cylindrical sealant backing where recommended, in width and depth recommended to provide proper depth and width of sealant bead. Ensure sealant cannot block weep system.
1. Install sealant under pressure to completely fill glazing channel without voids, with full bond to glass and channel surfaces.
 2. Tool sealant bead to proper profile providing wash away from glass.
- D. Sealant Glazing for Butt Glazing:
1. Brace glass in position for duration of glazing process
 2. Mask edges of glass at adjoining glass edges and between glass edges and framing members.
 3. Secure small diameter non-adhering foamed rod on back side of joint.
 4. Apply sealant to open side of joint in continuous operation; completely fill joint without displacing foam rod; tool sealant surface smooth to concave profile.
 5. Allow sealant to cure, then remove foam backer rod.
 6. Apply sealant to opposite side; tool sealant smooth to concave profile.
 7. Remove masking tape.
- E. Gasket Glazing: Fabricate gaskets to fit openings exactly. Allow for stretching of gaskets during installation.
1. Set soft compression gasket against fixed stop or frame, secure, with bonded miter cut joints at corners.
 2. Set glass lites centered in openings on setting blocks.
 3. Install removable stops, and insert dense compression gaskets at corners, working toward centers of lites, compressing glass against soft compression gaskets and to produce a weathertight seal. Seal joints in gaskets. Allow gaskets to protrude past face of glazing stops.

3.4 CLEANING AND PROTECTION

- A Protect installed glass from damage. Attach streamers or warning tape to framing members, away from contact with glass. Remove nonpermanent labels.

- B Protect glass from contact with contaminating substances during construction. Immediately clean glass exposed to contamination using methods recommended by glass manufacturer.
- C Within 5 working days prior to inspection for Substantial Completion, clean all exposed glass surfaces using methods recommended by manufacturer. Remove glazing compounds from framing surfaces.
- D Remove and replace broken or damaged glass.

8A-06. SECURITY LEVEL GLAZING N.A.

8A-07. ALUMINUM STOREFRONT AND SASH:

- A General: All aluminum tubing shown for fixed glass windows and windows shall be equal to Kawneer TriFab II 451 Series, 2" x 4 ½" or Vista Wall Series 3000 2" x 4 ½". Finish shall be Class 1 – clear anodized. Aluminum storefront shall be for Thermopane glazing.
- B Materials: All framing members shall be extruded aluminum of 6063-T6 alloy and temper. Exterior glazing gasket shall be E.P.D.M. and interior glazing seal shall be closed cell PVC foam sealant tape. All mullions and horizontals for 1" glazing (except butt glazed) shall be thermally isolated from the pressure plate by a rigid vinyl separator.
- C Installation: All openings shall be prepared plumb and square by others and shall be of sufficient size to provide clearance at jambs, head and sill as shown on the Architectural drawings. Experienced technicians shall perform installation, glass and glazing according to the manufacturer's recommended procedures. All units shall be securely anchored with all joints fully caulked to issue a watertight seal. Sills shall be laid in full bed of caulking and jambs and heads shall be caulked as shown on the drawings and specified elsewhere in these specifications. Installation shall be by skilled, well trained mechanics. Fastenings shall be Phillips Head Machine Screws counter sunk and of stainless steel.
- D Finish: All exposed surfaces shall be free of unsightly scratches and blemishes. The exposed surfaces shall receive a caustic etch followed by an architectural class I clear anodized coating conforming to AA-M12C22A44 Vista wall 740-EC.
- E Cleaning: Upon completion of construction, the General Contractor shall be responsible for cleaning all aluminum, employing methods recommended by the manufacturer as follows. Anodized aluminum shall be cleaned with plain water containing a mild detergent, or a petroleum product such as white gasoline, kerosene, or distillate. No abrasive agent shall be used.
- F Warranty: Provide standard limited two-year warranty from the date of substantial completion.
- G See drawings for locations for store front and fixed glass windows.

8A-08 GLAZED ALUMINUM CURTAIN WALLS: N.A.

8A-09. ALUMINUM FRAME ENTRANCE DOORS

- A. General: All aluminum entrances shall be series 500 wide stile door as manufactured by Vistawall Architectural products or series 500 Door as manufactured by Kawneer Company.

Doors and storefront systems to be of same manufacturer.

- B. Materials: All door and framing sections shall be of extruded aluminum alloy and temper to meet or exceed finishing and structural criteria as specified. Door stiles and rails, excluding glass stops, shall be tubular and have .125 wall thickness. All weathering shall be a hardbacked silicone treated polypropylene. Any exposed fasteners shall be aluminum, stainless steel or other non-corrosive material.

- C. Finish: All exposed surfaces shall be free of unsightly scratches and blemishes. The exposed sections shall receive a caustic etch followed by an anodic coating. Color shall be as selected by Architect from manufacturer's standard color chart.

- D. Construction and Design: Door stiles and rails shall be accurately joined at corners with heavy concealed reinforcement brackets secured with bolts and screws, and shall be MIG welded. Doors shall have snap-in stops with bulb glazing vinyl on both sides of the glass. No exposed screws shall be permitted. Each door leaf shall be equipped with an adjusting mechanism located in the top rail near the lock stile which provides for minor clearance adjustments after installation. Weathering shall be installed in the hinge stiles of pairs or single center hung doors. The lock stile of a single center hung door, active meeting stile at a pair of butt hung, offset pivot, or center hung doors shall have an adjustable astragal weather-strip. Pile sweep strip shall be applied to bottom rail of doors.

Door frame and sidelight framing shall be accurately joined at corners with unexposed screws. All glazing shall be flush, including the horizontal muntin and sills and held in place by E.P.D.M. glazing gaskets on both sides. No applied stops shall be permitted except at the transom bar of center hung doors. All butt-hung and offset pivot door frames shall have door stops at jambs and head with continuous weathering. tops on exterior side shall be lock in tamper proof type.

- E. Hardware: All doors shall be equipped with concealed closer in transom with back check. Operating hardware shall be offset pivot. Doors to be furnished with Kawneer C-90 paneline exit device and style "U" pull or Vistawall inline panic device and PH-5 pull. Furnish with 4" aluminum saddle threshold and install in full bed of mastic. Cylinder lock to be furnished under Hardware Section, these specifications.
- F. Erection: All openings shall be prepared plumb and square by others and shall be of sufficient size to provide clearance at jambs, head and sill as shown on the Architectural drawings. Installation, glass and glazing shall be performed by experienced technicians according to the manufacturer's recommended procedures. All units shall be securely anchored with all joints fully caulked to insure a water tight seal.
- G. Protection and Cleaning: After installation, the General Contractor shall adequately protect exposed portions of the aluminum entrance work from damage by grinding and

polishing compounds, plaster, lime, acid, cement or other contaminants.

Upon completion of construction, the general contractor shall be responsible for cleaning all aluminum, employing methods recommended by the manufacturer as follows: Anodized aluminum shall be cleaned with plain water containing a mild detergent, or a petroleum product such as white gasoline, kerosene or distillate. No abrasive agent shall be used.

8A-10. ALUMINUM WINDOWS N.A.

8A-11. SKYLIGHTS: N.A.

8A-12. SHOP DRAWINGS:

Glass and glazing contractor shall furnish complete shop drawings for all items this Section for approval prior to fabrication showing all details, sizes, shapes, dimensions, etc.

Shop Drawings shall show calculations, signed, and sealed by an engineer registered in the State of Florida, that all exterior glazing, windows, and store front comply with 131 mph ultimate wind speed as per the 2023 Florida Building Code and ASCE 7-10.

Shop Drawings shall also include product approval number and additional test data that is required to comply with the 2023 Florida Building Code. See Supplementary and Special Conditions, Paragraph 15-6.

8A-13. CLEANING:

After Final Inspection, all remaining glazing compound and smears shall be cleaned from the glass, the sash and frames, and the glass washed clean. Broken glass shall be removed and replaced at no expense to the Owner.

END OF SECTION.

**SECTION 8B
EXTERIOR AND INTERIOR DOORS**

8B-01. GENERAL CONDITIONS:

The General and Special Conditions, Division II, Sections E and F of these specifications shall apply to and form a part of this Section as if written in full herein.

8B-02. SCOPE:

Furnish all labor, materials, and equipment and perform all operations necessary for the complete installation of all glass, glazing, windows, and storefront as noted in these specifications and as shown in the drawings.

8B-03. CHAIN OPERATED SERVICE DOOR:

A. Furnish and install chain operated service doors as shown on drawings. Mounting shall be face of wall mounting. Door shall be as manufactured by the C.H.I. Overhead Doors. Furnished materials shall include curtain, bottom bars, brackets, guides, hood operating mechanism and all incidentals to make for a complete installation.

B. Materials:

1. The door curtain shall be constructed with 20-gauge No. 5 flat slats as designated by the C.H.I. Overhead Doors.
2. Door shall be shipped with one coat of corrosion inhibiting primer, 2 mils per side, for finish painting at the job site.
3. The bottom bar shall consist of two " steel angles mechanically joined together. The finish on the bottom bar shall be one (1) coat of bronze rust -inhibiting prime paint.
4. The guides shall consist of 3 steel angles bolted together with 3/8" fasteners to form a channel for the curtain to travel. The wall angle portion shall be continuous and fastened to the surrounding structure with either minimum 1/2" fasteners or welds both on 36" centers. The finish on the guide angles shall be one (1) coat of bronze rust-inhibiting paint.
5. The brackets shall be constructed of steel not less than 1/4" thick and shall be bolted to the wall angle with minimum 1/2" fasteners. The finish on the brackets shall be one (1) coat of bronze rust-inhibiting prime paint.
6. All gears shall be cast iron with teeth cast from machine cut patterns. The pinion gear shall not be less than a 3" pitch diameter. The gear ratio shall be designed for a maximum effort of not more than 30 pounds.
7. The barrel shall be steel tubing of not less than 4" in diameter. Oil tempered torsion springs shall be capable of correctly counter balancing the weight of the curtain. The barrel shall be designed to limit the maximum deflection to .03" per foot of opening width.

The springs shall be adjusted by means of an exterior wheel. The finish on the barrel shall be one (1) coat of bronze rust-inhibiting prime paint.

8. The hood shall be fabricated from 24-gauge galvanized steel and shall be formed to fit the curvature of the brackets. The hood shall be corrugated every 1" along the curvature for the entire length of the hood. The hood shall be finish in color as selected.

C. Operation:

9. Chain operated doors shall open and close with a maximum of 30 pounds of effort utilizing an endless chain and cast-iron reduction gears.

10. The chain door shall be secured by means of a chain lock.

D. Shop Drawings: Shop drawings shall be submitted for approval showing all details and shall also show that the door complies with the 131-mph wind speed as per the 2023 Florida Building Code.

E. Execution:

11. An authorized Cookson Distributor shall install all Cookson Rolling Service Doors.

12. All Cookson Rolling Service Doors shall be warranted for a period of twelve (12) months against defects in workmanship and materials from the time the building has been accepted.

8B-04. HOLLOW METAL DOORS: See Section 8C of these specifications.

8B-05 WOOD DOORS:

All wood doors shall be sized as scheduled on the drawings and shall be equal to the following specifications for door types.

- A. Hollow Core Doors: Shall be Graham seven-ply hollow core doors, 1-3/4" thick conforming to US Commercial Standard CS 171-58, including all amendments. Type I waterproof glue for exterior doors and Type II water resistant for interior doors. Hollow core doors shall be flush panel, Birch Veneer. Furnish one-year industry guarantee.

- B. Solid Core Doors: Shall be Graham exterior or interior solid lumber staved core doors, 1- 3/4 " thick, of sizes as noted on drawings. Doors noted for 20-minute rating shall be DGS-20 staved core. Doors shall conform to U.S.

Commercial Standard CS 171-58 including all amendments. Face veneer shall be Birch premium grade. Exterior doors shall be guaranteed for two (2) years after installation, interior doors for life of installation. Top and bottom edges to be at least 2 _ " minimum hardwood, side edges to be 1 3/4" minimum Beech.

- C. Fire Doors: Where noted on the drawings, rated or label wood doors shall be equal to Weyerhaeuser staved core DFM-60 fire door for a one-hour fire rating, conforming to industry standards I.S. 1-73. Door shall carry appropriate UL Label. Finish shall be Birch premium grade.

- D. Acceptable manufacturers are US Plywood, Roddis, or Eggers Hardwood Company; supplier to furnish submittal data showing all specifications of doors to be furnished for approval by Architect.

8B-06. METAL GLASS STOPS:

All wood doors shown or noted with glass lights shall have metal stops. Stops shall be Type FGS75 for single glazing and shall be as manufactured by Anemostat Door Products. **Install stops with stainless steel through bolts.**

8B-07. ALUMINUM FRAME ENTRANCE DOORS:

SEE SECTION 8A-09

8B-08. BULLET RESISTANT WOOD DOORS: **N.A.**

8B-09. PUSH UP COUNTER DOOR: **N.A.**

8B-10. PRODUCT APPROVAL NUMBERS: (METAL DOORS AND FRAMES)

Submittals for exterior hollow metal doors, metal door frames, exterior roll up doors, and exterior hollow metal window frames to have Florida Product Approval Numbers and information showing product complies with the Florida Building Code 2023. See Supplementary and Special Conditions, Paragraph 15-6 for this requirement.

Approval numbers shall be for the entire assembly (frames, doors, and hardware) including gauges of materials, setbacks of hardware anchorage and installation of all components.

END OF SECTION

SECTION 8C
HOLLOW METAL DOORS AND WINDOW FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 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 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. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
8. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.

9. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
10. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
11. ASTM E 413 - Classification for Rating Sound Insulation.
12. ASTM E1332 - Standard Classification for Determination of Outdoor-Indoor Transmission Class.
13. ASTM E1886 - Test Method for Performance of Exterior Windows, Curtain Walls, Doors and Shutters Impacted by Missiles and Exposed to Cyclic Pressure Differentials.
14. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Storm Shutters Impacted by Windborne Debris in Hurricanes.
15. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
16. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
17. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
18. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.
19. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
20. NFRC 400 – Procedure for Determining Fenestration Product Air Leakage.
21. TAS-201-94 - Impact Test Procedures.
22. TAS-203-94 - Criteria for Testing Products Subject to Cyclic Wind Pressure Loading.
23. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
24. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.3 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 (State of Florida): Within the State of Florida, provide copy of current State of Florida Product Approval or Metro-Dade County Notice of Acceptance (NOA) as proof of compliance that doors, frames and hardware for exterior opening assemblies have been tested and approved for use at the wind load and design pressure level requirements specified for the Project.
 - a. Hurricane Resistant Components (State of Florida): Within the State of Florida, provide copy of independent, third party certified listing conforming to ANSI A250.13.

1.4 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 Florida including High Velocity Hurricane Zone (HVHZ): Provide exterior hollow metal doors and frames as complete and tested assemblies, or component assemblies, including approved hardware specified under Section 087100 "Door Hardware", to meet the wind loads, design pressures, debris impact resistance, and glass and glazing requirements as detailed in the current State of Florida building code sections applicable to the Project.

1. Each unit to bear third party permanent label in accordance with Florida Building Code requirements.

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.

1.5 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.

1. 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.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 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.

1.8 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

2.1 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).
 - 3. Pioneer Industries (PI).
 - 4. Steelcraft (S).

2. MATERIALS

2

- 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. HOLLOW METAL DOORS

3

- 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 (Energy Efficient): Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A366 or 620. 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.

1. Core Construction: Steel stiffened laminated core with fiberglass filler with no stiffener face welds, in compliance with HMMA 867 "Laminated Core".
 - a. Provide 22 gauge steel-stiffeners at 6 inches on-center internally welded at 5" on-center to integral core assembly, No stiffener face welding is permitted.
 - b. Acoustical sound transmission rating shall be no less than STC 38 complying with ASTM E 90 and must be visible on factory applied labels.

2. Level/Model: Level 2 and Physical Performance Level A (Heavy Duty), Minimum 18 gauge (0.042 inch - 1.1-mm) thick steel, Model 2.

3. Vertical Edges: Vertical edges -to be mechanically interlocked with hairline seam. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).

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. 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.

5. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9".

6. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

D. 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.
 - a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.

2. Level/Model: Level 2 and Physical Performance Level B (Heavy Duty), Minimum 18 gauge (0.042-inch - 1.0-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.

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.

E. Manufacturers Basis of Design:

1. Curries Company (CU) - Polystyrene Core - 707 Series.

2.4 HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

- B. Thermal Break Frames: Subject to the same compliance standards and requirements as standard hollow metal frames. Tested for thermal performance in accordance with NFRC 102, and resistance to air infiltration in accordance with NFRC 400. Where indicated provide thermally broken frame profiles available for use in both masonry and drywall construction. Fabricate with 1/16" positive thermal break and integral vinyl weatherstripping.

- C. 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 14 gauge (0.067-inch -1.7-mm) thick steel sheet.
 - 3. Manufacturers Basis of Design:
 - a. Curries Company (CU) – M Series.

- D. 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.

- E. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.

- F. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.5 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.

2.6 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.

2.7 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.

2.8 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.

2.9 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:
- 1) Three anchors per jamb up to 60 inches high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
 - 3) Five anchors per jamb from 90 to 96 inches high.
 - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
 - 5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.
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

3.1 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.

3.2 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.

3.3 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:
 - a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.

- c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
- d. 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.

3.4 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.

3.5 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 8D
DOOR HARDWARE**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.
2. Sliding doors.
3. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 06 Section "Rough Carpentry".
2. Division 06 Section "Finish Carpentry".
3. Division 08 Section "Operations and Maintenance".
4. Division 08 Section "Door Schedule".
5. Division 08 Section "Hollow Metal Doors and Frames".
6. Division 08 Section "Flush Wood Doors".
7. Division 08 Section "Aluminum-Framed Entrances and Storefronts".

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.

1.3 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. Proof of Qualification: Provide copy of manufacturer(s) Factory Trained Installer documentation indicating proof of status as a qualified installer of Windstorm assemblies.

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 (State of Florida): Within the State of Florida, provide copy of current State of Florida Product Approval or Metro-Dade County Notice of Acceptance (NOA) as proof of compliance that doors, frames and hardware for exterior opening assemblies have been tested and approved for use at the wind load and design pressure level requirements specified for the Project.

a. Hurricane Resistant Components (State of Florida): Within the State of Florida, provide copy of independent, third party certified listing to ANSI A250.13.

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.

1.4 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.

F. Hurricane Resistant Exterior Openings (State of Florida including the High Velocity Hurricane Zone (HVHZ)): Provide exterior door hardware as complete and tested assemblies, or component assemblies, including approved doors and frames specified under Section 081113 "Hollow Metal Doors and Frames", to meet the wind loads, design pressures, debris impact resistance, and glass and glazing requirements as detailed in the current State of Florida building code sections applicable to the Project.

1. Each unit to bear third party permanent label in accordance with the Florida Building Code requirements.

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.

1.5 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".

1.6 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 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.

1.7 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. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:

1. Ten years for mortise locks and latches.
2. Twenty five years for manual overhead door closer bodies.

1.8 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

2.1 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.

2.2 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 certified 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:

- a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
- b. 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:

- a. 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:

- a. Hager Companies (HA).
- b. McKinney (MK).
- c. Stanley Hardware (ST).

2.3 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
2. Furnish dust proof strikes for bottom bolts.
3. Surface bolts to be minimum 8" in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.

5. Manufacturers:

- a. Door Controls International (DC).
- b. Rockwood (RO).
- c. Trimco (TC).

B. Door Push Plates and Pulls: ANSI/BHMA A156.6 certified door pushes and pulls 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. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.

5. Manufacturers:

- a. Hiawatha, Inc. (HI).
- b. Rockwood (RO).
- c. Trimco (TC).

2.4 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.

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).
 3. Construction Keys (where required): Ten (10).
- E. Construction Keying: Provide construction master keyed cylinders.
- F. 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.

2.5 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. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Operational Grade 1 Certified Products Directory (CPD) listed.
1. Vertical Impact: Exceed 100 vertical impacts (20 times ANSI/BHMA A156.2 requirements).
 2. Furnish with solid cast levers, standard 2 3/4" backset, and 1/2" (3/4" at rated paired openings) throw brass or stainless steel latchbolt.
 3. Locks are to be non-handed and fully field reversible.
 4. Manufacturers:
 - a. Corbin Russwin Hardware (RU) - CLX3300 Series.

2.6 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.

2.7 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. 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.
2. 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.
3. 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.
4. 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.
5. 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.
6. 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.

7. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
 8. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
 9. Rail Sizing: Provide exit device rails factory sized for proper door width application.
 10. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
 11. 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. Security Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed rim panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be constructed of high grade, heat treated, corrosion resistant nickel steel alloy, and have a full 3/4" throw projection with slide action positive deadlocking.
1. Static Load Force Resistance: Minimum 3000 lbs certified independent tested.
 2. Manufacturers:
 - a. Corbin Russwin Hardware (RU) - ED4000S / ED5000S Series.
 - b. Yale (YA) - 7050 Series.

2.8 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 (Large Body Cast Iron): 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 body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control.

1. Manufacturers:

- a. Corbin Russwin Hardware (RU) - DC8000 Series.
- b. Norton Rixson (NO) - 9500 Series.

2.9 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 certified 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.

6. Manufacturers:

- a. Hiawatha, Inc. (HI).
- b. Rockwood (RO).
- c. Trimco (TC).

2.10 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 certified 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:

- a. Hiawatha, Inc. (HI).
- b. Rockwood (RO).
- c. Trimco (TC).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Manufacturers:

- a. Norton Rixson (RF).
- b. Rockwood (RO).
- c. Sargent Manufacturing (SA).

2.11 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.

F. Manufacturers:

- 1. National Guard Products (NG).
- 2. Pemko (PE).
- 3. Reese Enterprises, Inc. (RE).

2.12 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.

2.13 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

3.1 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.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 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.

3.4 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.

3.5 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.

3.6 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.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 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.

B. Manufacturer's Abbreviations:

- 1. MK - McKinney
- 2. RU - Corbin Russwin
- 3. RO - Rockwood
- 4. RF - Rixson
- 5. PE - Pemko

Hardware Sets

SET NO. ONE

Doors No. 101 and 110, each door

- 1 Cylinder 7 PIN RPS

All other hardware by Door Supplier (See Section 8A-09)

SET NO. TWO

Doors: 102, 109, and 110A

- 3 Hinge, Full Mortise TA2714 4-1/2" x 4-1/2"
- 1 Pull Plate BF 110 x 70C
- 1 Push Plate 70C
- 1 Surface Closer DC8200 / 8210
- 1 Mop Plate K1050 4" X 1" LDW

1 Kick Plate	K1050 10" X 2" LDW
1 Door Stop	409 / 446 as required
1 Gasketing	S88D

SET NO. THREE

Doors: 103 and 113, each door

3 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Classroom Lock	CLX3355 NZD	626	RU
1 Surface Closer	DC8200 / 8210	689	RU
1 Kick Plate	K1050 10" X 2" LDW	US32D	RO
1 Door Stop	409 / 446 as required	US26D	RO
1 Threshold	271A MSES25SS		PE
1 Gasketing	S88D		PE
1 Sweep	315CN		PE

SET NO. FOUR

Doors: 105, 106, 107, and 108, each door

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Entrance Lock	CLX3351 NZD	626	RU
1 Door Stop	409 / 446 as required	US26D	RO
3 Silencer	608		RO

SET NO. FIVE

Doors: 112, 114, 115, and 116, each door

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Storeroom Lock	CLX3357 NZD	626	RU
1 Door Stop	409 / 446 as required	US26D	RO
3 Silencer	608		RO

SET NO. SIX

Doors: 118, 119, and 120, each door

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Privacy Lock	CLX3320 NZD	626	RU
1 Mop Plate	K1050 4" X 1" LDW	US32D	RO
1 Door Stop	409 / 446 as required	US26D	RO
1 Gasketing	S88D		PE

SET NO. SEVEN

Doors: 121A, 121B, and 121C, each door

3	Hinge, Full Mortise, Hvy Wt	T4A3386 X NRP 4-1/2" x 4-1/2"	US32D	MK
1	Rim Exit Device, Storeroom	ED5200S N959ET M107	630	RU
1	Surface Closer	DC8210 A11	689	RU
1	Kick Plate	K1050 10" X 2" LDW	US32D	RO
1	Threshold	2005AT MSES25SS		PE
1	Gasketing	303AS		PE
1	Rain Guard	346C x LAR		PE
1	Sweep	3452AV		PE

Notes: Hardware listed for design criteria, confirm with specific door manufacturer the hardware requirements to meet specified windstorm rating - Provide 3rd party test results for confirmation.

SET NO. EIGHT

Doors: 111, 121, AND 121D, each door

All door hardware by door manufacturer

END OF SECTION

SECTION 8E

ALUMINUM LOUVERS AND BRICK VENTS

8E-01. ALUMINUM LOUVERS AND BRICK VENTS:

- A. Manually operated louvers: Shall be in sizes and shapes as shown on the drawings equal to Construction Specialties, Inc., Aluminum Model 4830 M for manual operation. Louver blades to be storm proof type center pivoted with two reinforcing bosses. Furnish with aluminum insect screen on exterior side and an aluminum expanded metal screen on the interior side. Expanded metal shall be equal to 1/2", 081 standard expanded aluminum and set in a screened or heavy duty extruded aluminum frame.

Finish to be C/S Kynar 500 coating in color as selected by Architect.

- B. Louvers (Fixed): Furnish and install at locations shown and in sizes and shapes shown, aluminum fixed louvers equal to Construction Specialties Model 4110 storm proof for louver widths or diameters up to 24" and Model 4130 storm proof for louver widths or diameters over 24".

All louvers to be furnished complete with C/S insect screen and an aluminum expanded metal screen on the interior side set in a screwed on heavy duty extruded frame. The expanded metal shall be equal to .081 standard expanded aluminum.

Frames and blades to be 6063-T52 alloy minimum .081" for 4110 louvers and .125" for 4130 louvers, with reinforcing bosses. Heads, jambs, and sills to be one piece structural members and to have integral caulking slot and retaining bead. All fastenings to be stainless steel.

Structural supports to be designed by C/S to carry a wind load of not less than 20 pounds p.s.f.

Finish to be C/S Kynar 500 coating in color as selected by Architect.

- C. Brick Vents: Shall be in sizes as shown on the mechanical drawings and equal to Construction Specialties, Inc., Aluminum Brick Vent.

Model 22EX for 16 x 4-7/8 vents

Model 23EX for 16 x 7-3/4 vents

Vents shall include 7 x 7 mesh aluminum screen, continuous drip top and bottom, weep holes and minimum wall thickness of .125".

Coordinate with mechanical contractor for exact location and installation for proper connection to FIA duct.

Finish shall be Kynar 500 finish in color selected by Architect.

D. Motorized Louvers: N.A.

END OF SECTION

SECTION 9A

CERAMIC TILE

9A-01. **GENERAL CONDITIONS:**

The General and Special Conditions, Division II, Sections E and F of these specifications shall apply to and form a part of this Section as if written in full herein.

9A-02. **SCOPE:**

Furnish all labor, materials, equipment and services necessary and/or required to install all ceramic and quarry floor tile and base where scheduled on the drawings and as indicated. All tile patterns and colors shall be as approved and selected by the Architect. Tile work shall be performed in accordance with Standards of the Tile Council of American

9A-03. **SAMPLES AND CERTIFICATES OF GRADE:**

The Contractor shall submit to the Architect for approval three (3) samples of each type of tile he proposes to use. Package shall be branded with a shipping mark stating grade and shall be subject to the inspection of the Architect.

9A-04. **CERAMIC FLOOR TILE:**

A. **Materials:**

1. In Areas where noted and where shown on the Room Finish Schedule:
 - a. **Floor Tile:** Shall be American Olean Unpolished terra pavers 12" x 12" (11 13/16" x 11 13/16") x 11/32" . In toilet rooms tile size shall be 8' x 8" (7 7/8" x 7 7/8" x 5/16"). Floor tile shall be Price Range One. Floor tile shall be non-slip
 - b. **Base:** Shall be 6" high coved base
 - c. **Grout:** Grout to be equal to Bonsal Epoxy Grout for tile and a sanded grout for wall tile.
 - d. Tile and grout colors will be as selected by Architect.

NOTE: In some areas two colors of tile may be used, Architect will provide the pattern to the successful bidder.

B. **Installation:**

1. **Floor Tile:** Shall be laid with a thin set grout over new concrete floors and a 1/4"

grout joint and installed in accordance with ATC F112-93.
Floor tile laid in rooms with floor drains to be installed so positive slope to floor drains are provided.

2. See Demolition Plan for the removal of all existing ceramic floor tile.
3. It will be the responsibility of the ceramic tile subcontractor to prepare the existing concrete floors by sanding, grouting, cleaning, etc. after the existing tile has been remove, to properly receive new floor tile.

9A-05 CERAMIC WALL TILE: N.A.

9A-06. QUARRY TILE: N.A.

9A-07. MARBLE THRESHOLDS:

The tile contractor shall furnish and install a marble threshold at every door opening or location where ceramic tile or quarry tile abut a different type of flooring and/or at any location noted on the drawings.

The marble threshold shall be 1 3/8" thick and width as required. The threshold shall be beveled and installed so the bottom of the bevel projects no more than 1/4" above the surface of either adjoining flooring material.

9A-08. TOILET ACCESSORIES:

See Miscellaneous Metals and Specialties Section.

9A-09. SUBMITTAL:

Contractor to submit samples of each material specified in this section along with manufacturers catalog and specifications for each of the materials.

9A-10. CLEANING:

On completion of tile work the floor and wall tile shall be thoroughly cleaned and polished. Before any traffic is permitted on the floor the walls and floor shall be sealed in an approved two-coat application, and when sealer is dry, the entire floor area covered with 20# building paper which shall be maintained in good condition until removal just prior to the Final Inspection. Sealer shall be equal to "Clear Bond" by Guardian Chemical Company.

CITY OF MARIANNA
SECTION 9A

MARIANNA MUNICIPAL AIRPORT
HANGAR DEVELOPMENTS

9A-11. GUARANTEE:

This Contractor shall furnish guarantee of all ceramic and quarry tile materials and workmanship for a period of one (1) year from date of final acceptance of building.

END OF SECTION.

SECTION 9B

RESILIENT TILE, CARPET TILE, AND RUBBER BASE

9B-01. GENERAL CONDITIONS:

The General and Special Conditions, Division II, Sections E and F, of these specifications shall apply to and form a part of this Section as if written in full herein.

9B-02. SCOPE:

Provide all labor, materials and equipment necessary to install new floor covering and base where shown and scheduled on the drawings and as specified.

9B-03. RESILIENT TILE FLOORING

1) GENERAL

(1) RELATED DOCUMENTS

- (a) Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

(2) SUMMARY

- (a) Section Includes:

- (i) Solid vinyl floor tile.

(3) ACTION SUBMITTALS

- (a) Product Data: For each type of product.

- (b) Sustainable Design Submittals:

- (i) Product Data: For adhesives, indicating VOC content.
 - (ii) Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
 - (iii) Laboratory Test Reports: For flooring products, indicating compliance with requirements for low-emitting materials.

- (c) Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

(i) Show details of special patterns.

(d) Samples: Full-size units of each color and pattern of floor tile required.

(e) Product Schedule: For floor tile. [Use same designations indicated on Drawings.]

(4) INFORMATIONAL SUBMITTALS

(a) Qualification Data: For Installer.

(5) CLOSEOUT SUBMITTALS

(a) Maintenance Data: For each type of floor tile to include in maintenance manuals.

(6) MAINTENANCE MATERIAL SUBMITTALS

(a) Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

(i) Floor Tile: Furnish one box for every 100 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

(7) QUALITY ASSURANCE

(a) Installer Qualifications: A qualified installer with a minimum of 5 years commercial resilient flooring installation experience, and who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

(i) Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

(b) Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

(i) Build mockups for floor tile including resilient base and accessories.

1. Size: Minimum 100 sq. ft. (9.3 sq. m) for each type, color, and pattern and locations as shown on drawings.

(ii) Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

- (iii) Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

(8) 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, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

(9) FIELD CONDITIONS

- (a) HVAC system should be operational and running for a minimum of 7 days prior to resilient tile installation and remain running after resilient tile installation.
- (b) Maintain ambient temperatures within range recommended by manufacturer, but not less than 65 deg F (18 deg C) or more than 85 deg F (29 deg C), in spaces to receive floor tile during the following time periods:
 - (i) 48 hours before installation.
 - (ii) During installation.
 - (iii) Permanently after installation.
- (c) Close spaces to traffic during floor tile installation.
- (d) Close spaces to traffic, all heavy rolling loads, and point loads for 48 to 72 hours after floor tile installation.
- (e) Install floor tile after other finishing operations, including painting, have been completed.

(10) WARRANTY

- (a) Special Warranty for Resilient Tile; Manufacturer agrees to repair or replace defective material within specified warranty period.
 - (i) Warranty does not include installer's workmanship.
 - (ii) Resilient tile must be installed and maintained according to manufacturer's recommendations.
 - (iii) Warranty Period:
 1. Manufacturing Defects Warranty: 10 years.
 2. Limited Commercial Wear Warranty: 10 years.
 3. Under bed Warranty: 10 years. (Requires Shaw 4100 or S150 adhesive.)

2) PRODUCTS

(1) PERFORMANCE REQUIREMENTS

- (a) Fire-Test-Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - (i) Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- (b) Flooring products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

(2) SOLID VINYL FLOOR TILE

- (a) Basis-of-Design Product: Subject to compliance with requirements, provide Patcraft Typeface I312V.
- (b) Tile Standard: ASTM F 1700.
 - (i) Class: Class III, printed film vinyl tile.
 - (ii) Type: A Smooth.
- (c) Overall Thickness: 0.098 inch (2.5 mm).
- (d) Wear Layer: 20 mil (0.5 mm) ExoGuard™ Quatrz Enhanced Urethane.
- (e) Wear Layer Thickness: 0.020 inch (0.5 mm).
- (f) Size: 23-5/8 by 23-5/8 inches (600mm by 600 mm).
- (g) Colors and Patterns: As selected by Architect from full range of manufacturer's designations.
- (h) Test Data:
 - (i) Slip Resistance: ASTM D 2047, ADA Compliant.
 - (ii) Static Load, ASTM F 970: 2000 psi (lbs.sq.in) – 0.005 in.
 - (iii) Residual Indentation, ASTM 1914: Passes <8%
 - (iv) Flexibility, ASTM F 137: Passes.
 - (v) Dimensional Stability: Federal Standard #501A, Method 6211 >0.02"/ft.
 - (vi) Resistance to Heat, ASTM F 1514: Passes.
 - (vii) Resistance to Light, ASTM F 1515: Passes.
 - (viii) Resistance to Chemicals, ASTM 925: Passes.
 - (ix) Resistance to Fungi, ASTM G 21: Passes, Rate zero (Rate zero: Fungi Free).

- (x) Antibacterial Activity, AATCC 147: Passes, resists the propagation of bacteria.
- (xi) Radiant Flux, ASTM E 648: greater than 0.45 watts/cm, NFPA Class I.
- (xii) Smoke Density, ASTM E 662: less than 450, Passes.

(3) INSTALLATION MATERIALS

- (a) Trowel-able Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- (b) Adhesives: Water-resistant adhesive such as the Shaw 4100 or Shaw S150 to suit floor tile and substrate conditions indicated.
 - (i) Adhesives shall have a VOC content of 50 g/L or less.
 - (ii) Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- (c) Floor Polish: Floor Finish is optional. If floor finish is desired, provide protective, neutral pH liquid floor-polish products recommended by floor tile manufacturer.

3) EXECUTION

(1) EXAMINATION

- (a) Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - (i) 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.
- (b) Proceed with installation only after unsatisfactory conditions have been corrected.

(2) PREPARATION

- (a) Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- (b) Concrete Substrates: Prepare according to ASTM F 710.

- (i) Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
- (ii) Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
- (iii) Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 10 pH.
- (iv) Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:
 - 1. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates are below 90 percent relative humidity level.
- (c) Fill cracks, holes, and depressions in substrates with trowel-able leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- (d) Do not install floor tiles until they are the same temperature as the space where they are to be installed.
 - (i) At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- (e) Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

(3) 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.
 - (i) 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.
 - (i) Lay tiles in pattern of colors and sizes indicated.
- (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 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.

(4) CLEANING AND PROTECTION

- (a) Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- (b) Perform the following operations immediately after completing floor tile installation:
 - (i) Remove adhesive and other blemishes from exposed surfaces.
 - (ii) Sweep and vacuum surfaces thoroughly.
 - (iii) Damp-mop surfaces to remove marks and soil.
- (c) Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- (d) Optional Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.
- (e) Cover floor tile until Substantial Completion.

9B-04. CARPET TILE

(1) RELATED DOCUMENTS

- (a) Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

(2) SUMMARY

- (a) Section includes modular, **[tufted] [needle-punched]** carpet tile.
- (b) Related Requirements:
 - (i) Section 024119 "Selective Demolition" for removing existing floor coverings.
 - (ii) Section 096513 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.
 - (iii) Section 096816 "Sheet Carpeting" for carpet roll goods.

(3) PREINSTALLATION MEETINGS

- (a) Preinstallation Conference: Conduct conference at project site.
 - (i) Review methods and procedures related to carpet tile installation including, but not limited to, the following:
 1. Review delivery, storage, and handling procedures.
 2. Review ambient conditions and ventilation procedures.
 3. Review subfloor preparation procedures.
 4. Follow manufacturer's modular carpet installation guidelines and/or Carpet & Rug Institute Installation Standard 104 where applicable.

(4) ACTION SUBMITTALS

- (a) Product Data: For each type of product.
 - (i) Include manufacturer's written specifications and lab documents for any physical testing.
 - (ii) Include manufacturer's written installation recommendations for each type of substrate as specified in carpet manufacturer's installation guidelines and/or Carpet & Rug Institute Installation Standard 104, where applicable.
 - (iii) Include carpet maintenance recommendations as outlined by the carpet manufacturer.
 - (iv) Carpet Manufacturer shall also submit a plan for recycling the specified carpet at the end of the useful life of the carpet.
- (b) Sustainable Design Submittals:
 - (i) **Product Data**: For adhesives, indicating VOC content.
 - (ii) **Laboratory Test Reports**: For adhesives, indicating compliance with requirements for low-emitting materials.
 - (iii) **Laboratory Test Reports**: For flooring products, indicating compliance with requirements for testing and product requirements of CRI's "Green Label Plus" testing program.
 - (iv) **Laboratory Test Reports**: For flooring products, indicating compliance with requirements for low-emitting materials.

- (c) Shop Drawings: For carpet tile installation, plans showing the following:
 - (i) Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - (ii) Carpet tile type, color, and dye lot.
 - (iii) Type of subfloor.
 - (iv) Type of installation.
 - (v) Pattern of installation.
 - (vi) Pattern type, location, and direction.
 - (vii) Installation method (monolithic, quarter turn, ashlar, brick random, interactive patterning).
 - (viii) Type, color, and location of insets and borders.
 - (ix) Type, color, and location of edge, transition, and other accessory strips.
 - (x) Transition details to other flooring materials.

- (d) Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - (i) Carpet Tile: Full-size Sample.
 - (ii) Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.

- (e) Samples for Initial Selection: For each type of carpet tile.
 - (i) Include Samples of exposed edge, transition, and other accessory stripping involving color or finish selection.

 - (f) Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - (i) Carpet Tile: Full-size Sample.
 - (ii) Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.

- (g) Product Schedule: For carpet tile. Use same designations indicated on Drawings.

- (h) Sustainable Product Certification: Provide ANSI/NSF 140 certification for carpet products.

(5) INFORMATIONAL SUBMITTALS

- (a) Qualification Data: For Installer.

- (b) Product Test Reports: For carpet tile, for tests performed by a qualified independent testing agency.

(6) CLOSEOUT SUBMITTALS

- (a) Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
 - (i) Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - (ii) Precautions for cleaning materials and methods that could be detrimental to carpet tile.

(7) MAINTENANCE MATERIAL SUBMITTALS

- (a) Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - (i) Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10.67 sq. yd. (8.9 sq. m).

(8) QUALITY ASSURANCE

- (a) Manufacturer Qualifications: Carpet manufacturer shall have no less than 5-years experience of producing recyclable carpet tile and shall have published product literature clearly indicating compliance with requirements of this section.
 - (i) Certification: ISO 9001 and ISO 14001 certified manufacturer.
 - (ii) Commitment to Sustainability: Carpet manufacturer must practice environmental responsibility through programs of recycling, reuse, conservation, and source reduction. Manufacturer should have a public demonstration of such efforts through reporting documents such as an annual sustainability report that contains third party verification and confirmation.
 - (iii) Carpet manufacturer must take back modular carpet tile to be recycled free of charge for quantities of 500 sq. yards (418 sq. m) or more within continental U.S. Program variations exists for other some geographical locations.
- (b) Installer Qualifications: An installer with a minimum of 5 years commercial carpet installation experience, and who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.
- (c) Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 - (i) Build mockups at locations and in sizes shown on Drawings.
 - (ii) Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

(9) DELIVERY, STORAGE, AND HANDLING

- (a) Comply with carpet manufacturer's installation recommendations and the Carpet & Rug Institute Installation Standard 104 where applicable.

(10) FIELD CONDITIONS

- (a) Comply with carpet manufacturer's installation recommendations and the Carpet & Rug Institute Installation Standard 104 for temperature, humidity, and ventilation limitations.
- (b) Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.
- (c) HVAC system should be operational and running prior to carpet installation and remain running after carpet installation.
- (d) Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to allow bond between adhesive and concrete. Concrete slabs should have moisture and pH readings that are within the specified tolerance of the adhesive to be used.
- (e) Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

(11) WARRANTY

- (a) Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 - (i) Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 - (ii) Failures include, but are not limited to, the following:
 1. More than 10 percent face fiber loss, and edge raveling.
 2. Dimensional instability.
 3. Excess static discharge.
 4. Loss of tuft-bind strength.
 5. Delamination.
 6. Where face fiber is 100 percent solution dyed, in ability to remove acid based stains.
 7. Lack of colorfastness to atmospheric contaminants.
 - (iii) Warranty Period: Lifetime Commercial Limited Warranty.

2) PRODUCTS

(1) CARPET TILE

(a) Basis-of-Design Product: Subject to compliance with requirements; **Patcraft, 10239 Speak In Color** or comparable product by one of the following:

- (i) [Interface, LLC.](#)
- (ii) J&J Invision; J&J Industries, Inc.
- (iii) [Mannington Mills, Inc.](#)
- (iv) [Tandus; a Tarkett company.](#)

(b) Source Limitations:

- (i) Single Source Responsibility: Provide products that have components manufactured by a single source. Fiber and backing, as well as final carpet product, should be manufactured and warranted by same company.
- (ii) Commitment to sustainability: Carpet manufacturer must practice environmental responsibility through programs of source reduction, recycling, reuse, and conservation.

(c) Color: **As selected by Architect from manufacturer's full range**

(d) Pile Characteristics: **Multi Level Pattern Loop** pile.

(e) Fiber Content: **Nylon - 100 percent trilobal, minimum 24 denier per filament DPF nylon 6. Fiber must contain a minimum of 25 percent recycled content.**

(f) Fiber Name: **Eco Solution Q Nylon**

(g) Dye Method: **100 percent Solution Dye.**

(h) Gauge: **1/12 ends per inch (mm)>.**

(i) Stitches: **10 stitches per inch (mm)>.**

(j) Surface Pile Weight: **18 oz./sq. yd. (g/sq. m)>.**

(k) Density: **7200 oz./cu. yd. (g/cu. cm)>.**

(l) Primary Backing: Nonwoven synthetic.

(m) Secondary Backing: High performance precoat laminated to a proprietary thermoplastic polyolefin compound with a fiberglass reinforced layer. Backing must contain a minimum of 40 percent recycled content and be SCS NSF 140 Gold certified. Backing should be recyclable, PVC free, free of 4-PCH, brominated flame retardants, and phthalate plastizers.

- (i) Total Backing Weight: Not to exceed **80 oz./sq yd** (339.1 g/sq m).
- (n) Backing System: Non PVC.
- (o) Applied Treatments:
 - (i) Soil-Resistance Treatment: [**Other**] [**None**].
- (p) Total Weight: **91 oz./sq. yd.** for finished carpet tile.
- (q) Size: [**24 by 24 inches (610 by 610 mm)**] [**18 by 36 inches (457 by 914 mm)**].
- (r) Texture Appearance Retention Rating (T.A.R.R.):
 - (i) Appearance Retention Rating (T.A.R.R.): **Severe**.
- (s) Recycling Requirements:
 - (i) Total Carpet Product Recycled Content:
 1. Pre-Consumer Recycled Content: **36.200000000000003** percent.
 2. Post-Consumer Recycled Content: **0** percent.
 3. Total Recycled Content: **36.200000000000003** percent.
 - (ii) Recycled Content: Preference will be given to manufacturer's recycling reclaimed carpet tile backing into new carpet tile, thus backing to backing.
 - (iii) Carpet Disassembly and Recycling: Carpet capable of disassembly and recycling, with nylon being recycled and backing being recycled into new backing.
 - (iv) Carpet product must meet guidelines of Presidential Executive Order 13101, and must meet the spirit of section 6002 of the Resource and Recovery Act (RCRA).
- (t) Sustainable Design Requirements:
 - (i) Sustainable Product Certification: Gold level certification according to ANSI/NSF 140.
 - (ii) Carpet and cushion shall comply with testing and product requirements of Carpet & Rug Institute's "Green Label Plus" testing program.
- (u) Performance Characteristics:
 - (i) Critical Radiant Flux Classification, Flooring Radiant Panel ASTM E 648: Not less than 0.45 W/sq. cm.
 - (ii) Smoke Density: Less than 450 per ASTM E662.
 - (iii) Methanamine Pill Test CPSC FF1-70: Must pass pill test.
 - (iv) Tuft Bind: Not less than **8 lbf (36 N)** according to ASTM D 1335.
 - (v) Delamination: Not less than **3.5 lbf/in. (0.6 N/mm)** according to ASTM D 3936.
 - (vi) Dimensional Tolerance: Within **1/32 inch (0.8 mm)** of specified size dimensions, as determined by physical measurement.

- (vii) Dimensional Stability: 0.119 percent or less according to ISO 2551 (Aachen Test).
- (viii) Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 129 and AATCC 164.
- (ix) Colorfastness to Light: Not less than 4 after 60 AFU (AATCC fading units) according to AATCC 16, Option E.
- (x) Electrostatic Propensity: Less than 3.5 kV according to AATCC 134.

(2) INSTALLATION ACCESSORIES

- (a) Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- (b) Trowelable Adhesives: Water-resistant, mildew-resistant, nonstaining, premium grade pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation using a premium pressure sensitive adhesive where slab moisture does not exceed 85 percent per ASTM F 2170 or 5 lbs (2.27 kg) per ASTM F 1869. Where slab moisture does not exceed 85 percent and antimicrobial protection is needed to pass AATCC 174, use a mill specified antimicrobial adhesive. Where moisture exceeds 85 percent or 5 lbs (2.27 kg) but does not exceed 90 percent or 10 lbs (4.56 kg), use a mill specified primer.
 - (i) Adhesives shall have a VOC content of [50] <Insert value> g/L or less.
 - (ii) Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 - (iii) Adhesives shall comply with the testing and product requirements of the Carpet and Rug Institute Green Label Plus Program.
- (c) Non-Trowelable Adhesive: Water-resistant, mildew-resistant, non-staining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation using a non trowelable adhesive where slab moisture does not exceed 95 percent per ASTM F 2170 or 10 lbs (4.56 kg) per ASTM F 1869. Each carpet tile must be adhered to the subfloor.
- (d) Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

3) EXECUTION

(1) EXAMINATION

- (a) Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.
- (b) Examine carpet tile for type, color, pattern, and potential defects prior to installation. See manufacturer's requirements for substrate conditions and ambient conditions.
- (c) Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.
 - (i) Lightweight concrete and gypcrete subfloors may require a liquid latex primer to reduce surface porosity.
 - (ii) Where previous surface treatments are unknown, or where other concerns exist as to the ability of the adhesive to bond to the substrate, a 24 hour bond test is recommended.
- (d) Wood Subfloors: Verify the following:
 - (i) Underlayment over subfloor complies with requirements specified in Section 061600 "Sheathing."
 - (ii) Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.
 - (iii) Unfinished wood should be primed using a liquid latex primer.
- (e) Metal Subfloors: Verify the following:
 - (i) Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.
- (f) Painted Subfloors: Perform bond test recommended in writing by adhesive manufacturer.
 - (i) Access Flooring Systems: Verify the following:
 - (ii) Access floor substrate is compatible with carpet tile and adhesive if any.
 - (iii) Underlayment surface is flat, smooth, evenly planed, tightly jointed, and free of irregularities, gaps greater than [**1/8 inch (3 mm)**], protrusions more than **1/32 inch (0.8 mm)**, and substances that may interfere with adhesive bond or show through surface.
- (g) Proceed with installation only after unsatisfactory conditions have been corrected.

(2) PREPARATION

- (a) General: Comply with Carpet & Rug Institute Installation Standard 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
- (b) Use trowelable leveling and patching compounds that contain a cementitious base with a latex additive, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions **1/8 inch (3 mm)** wide or wider, and protrusions more than **1/32 inch (0.8 mm)** unless more stringent requirements are required by manufacturer's written instructions.
- (c) Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
- (d) Metal Substrates: Clean grease, oil, soil and rust, and prime if recommended in writing by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.
- (e) Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

(3) INSTALLATION

- (a) General: Comply with CRI's "Carpet & Rug Institute Installation Standard 104, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.
- (b) Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive. Any non-spreadable adhesive system must adhere the carpet to the substrate.
- (c) Maintain dye-lot integrity. Do not mix dye lots in same area unless the specific carpet style in manufactured as a merge-able dye lot product.
- (d) Maintain pile-direction patterns as recommended in writing by carpet tile manufacturer.
- (e) Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- (f) Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

- (g) Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- (h) Install pattern parallel to walls and borders.
- (i) Roll the entire installation with a 75 lb roller once installation is completed.
- (j) Access Flooring: Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

(4) CLEANING AND PROTECTION

- (a) Perform the following operations immediately after installing carpet tile:
 - (i) Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - (ii) Remove yarns that protrude from carpet tile surface.
 - (iii) Vacuum carpet tile using commercial machine with face-beater element.
- (b) Protect installed carpet tile to comply with Carpet & Rug Institute Installation Standard 104, "Protecting Indoor Installations."
- (c) When construction or move-in activities will continue where new carpet is installed, provide non-staining building material paper to protect carpet. Do not use plastic sheeting as it can trap moisture, and self-sticking plastic sheeting can transfer adhesive residue to carpet that will attract soil.
- (d) When heavy objects are moved over carpet within 24 hours of installation, use plywood over carpet to prevent buckling and wrinkling.
- (e) Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

9B-05. RUBBER BASE:

Where noted, base shall be 4" high **rubber** base equal to Roppe or Johnsonite. **Internal and external corners shall be premolded.** Apply with full bed of mastic so base adheres uniformly to wall surface. Color to be selected by Architect.

9B-06. GUARANTEES:

This Contractor shall furnish a 2-Year Guarantee for workmanship and installation and defective materials for the installation of all the floor covering specified in this section, and in addition,
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shall furnish a 10-Year Warranty from the carpet manufacturer for delamination, edge ravel and excessive wear. Guarantees to be dated date of acceptance of building.

9B-07. RESILIENT ATHLETIC FLOORING: N.A.

END OF SECTION.

SECTION 9D

ACOUSTICAL TREATMENT

9D-01. **GENERAL CONDITIONS:**

The General and Special Conditions, Division II, Sections E and F of these specifications shall apply to and form a part of this Section as if written in full herein.

9D-02. **SCOPE:**

The work to be done under this heading includes the furnishing of all labor, equipment, services, and materials necessary for, or reasonably incidental to, making a complete installation of the suspended acoustical tile ceilings in strict accordance with these specifications and/or as indicated on the drawings. No deviation from these specifications shall be allowed unless approved by the Architect in writing prior to bid date. All acoustical materials and suspension systems shall be installed by a subcontractor thoroughly experienced in this type of work and approved by the manufacturer. **It shall be the responsibility of the acoustical contractor to provide adequate support for the light fixtures and it shall be this contractor's responsibility to coordinate his work with the electrical and mechanical contractors. This contractor is to arrange for adequate anchorage to the frame system.**

9D-03. **NON-BEVELED EDGE SUSPENDED GRID LAY IN TILE CEILING SYSTEM:**

A. **Grid System:** Shall be Prelude XL 15/16" suspended exposed tee grid as manufactured by Armstrong World Industries, Inc.

1. **Components:** All main beams and cross tees shall be commercial - quality hot dipped galvanized steel. Exposed surfaces chemically cleansed, capping prefinished in baked polyester pain. Main beams and cross tees are double-web steel construction with 15/16" type exposed flange design column strength and staked-on end detail allowing easy cross tee removal and remounting. Main beams shall be 1 ½" spaced not more than 4'0" o.c. Cross tees shall be 1 ½". Wall molding shall be #7800 with ½ " exposed flange. Hanger wire shall be 12-gauge galvanized carbon steel.
2. **Finish:** All steel roll-formed parts, including cap, shall be chemically cleansed. Capping shall be prefinished in a baked polyester paint finish. Color shall be WHITE and match the actual color of the selected ceiling tile, unless other specified. Off white not acceptable.

B. **Ceiling Lay-in Tile Units:**

- 1 Lay-in tile units shall be Armstrong Mineral Fiber Ceiling Tile Units, Georgian #764 Pattern with and exposed grid system, Humiguard Plus, 24" x 24" x 5/8". Tile units shall be Class "A". Have a light reflectance of LR-1 (over 75%), and N.R.C. range of .50-.60, and an STC range of 35-29.

9D-04. BEVELED EDGE SUSPENDED GRID LAY IN TILE CEILING SYSTEM: N.A.

9D-05. KITCHEN ZONE, SUSPENDED GRID LAY IN TILE CEILING SYSTEM:

A. Grid System: Shall be Prelude XL 15/16" suspended exposed tee grid as manufactured by Armstrong World Industries, Inc.

1. Components: All main beams and cross tees shall be commercial - quality hot dipped galvanized steel. Exposed surfaces chemically cleansed, capping prefinished in baked polyester pain. Main beams and cross tees are double-web steel construction with 15/16" type exposed flange design column strength and staked-on end detail allowing easy cross tee removal and remounting. Main beams shall be 1 1/2" spaced not more than 4'0" o.c. Cross tees shall be 1 1/2". Wall molding shall be #7800 with 7/8" exposed flange. Hanger wire shall be 12-gauge galvanized carbon steel.
2. Finish: All steel roll-formed parts, including cap, shall be chemically cleansed. Capping shall be prefinished in a baked polyester paint finish. Color shall be WHITE and match the actual color of the selected ceiling tile, unless other specified. Off white not acceptable.

B. Ceiling Lay-in Tile Units:

- 1 Lay-in tile units shall be Armstrong Kitchen Zone, Smooth Texture Square Lay-in Tile #673, 24" x 24" x _" with the following characteristics:

Acoustical Performance	CAC Rating 33
Fire Rating	Class A
Light Reflectance	0.89
Anti-Mold & Mildew	Bio-Block High Level of Performance
Sag Resistance	Humi Guard High level of Performance
VOC Emissions	Certified Low Level
Durability	Water Repel. Scratch Resistant, Soil Buildup Resistant, & Washable
Warranty	30 years

9D-06. ACOUSTICAL CEILING TILE TRIM: N.A.

9D-07. INSTALLATION AND COORDINATION:

Main "T" runners shall be of not more than 48" centers and supported by 12-gauge wire to joist or structural system members (no hanging from ducts, piping, etc.); use unistrut members where required. Each corner of light fixture shall also be supported by hanger wires. "T" spline intersecting moldings shall be locked in place. All runners and splines shall be straight or in alignment and flush at intersections. **Edge molding shall be mitered at all corners, internal and external.**

Exterior doors shall be hung, and all doors and windows glazed and all wet work completely dry before starting this work. Areas shall be broom clean before proceeding with this work.

The contractor shall extend complete coordination to and with the mechanical and electrical contractors in coordination of the work. Tile shall be centered one room and lighting fixtures, and ceiling grilles shall be centered in tiles. A reflected ceiling plan is included in the architectural drawings, and it is the responsibility of the ceiling sub-contractor to verify their accuracy and to bring to the Architect's attention any areas that will create shifting of grid or mechanical or electrical items.

9D-08. EXTRA TILE: **N.A.**

9D-09. ACOUSTICAL WALL PANELS: **N.A.**

9D-10. ACOUSTICAL BARREL DIFFUSERS N.A.

9D-11. CLEAN-UP:

The Contractor shall remove all debris, scrap, etc., from the site upon completion of his work. Tile shall be free of fingerprints, smudges, and present a uniform color, clean and level. Any tile found to contain smudges, chips, etc., shall be removed and replaced with new tile.

9D-12. GUARANTEE:

This contractor shall guarantee in writing the materials and workmanship for a period of two (2) years after final acceptance of the building.

9D-13 EGG CRATE CEILING: **N.A.**

END OF SECTION.

SECTION 9E

PAINTING

9E-01. GENERAL CONDITIONS:

The General and Special Conditions, Division II, Sections E and F of these specifications shall apply to and form a part of this Section as if written in full herein.

9E-02. SCOPE:

Furnish all labor, materials, equipment and services necessary and/or incidental to do all painting and decorating under this Contract.

In general, but not limited to, this contractor will include:

- A. Three (3) coats of paint on all new work exterior and interior, including plaster, stucco, sheetrock, block masonry walls, trim, and metal.
- B. Finishing of all cabinet work and paneling except that which is covered by plastic laminate, or that which is finished at the mill.
- C. Epoxy coating of all walls and ceilings where called for on the schedule.
- D. Painting of concrete floors where called for on the drawings.

9E-03. GENERAL REQUIREMENTS:

Mix all paints at least seventy-two (72) hours before using, keeping the containers covered during this period. Mix well before using. All paint to come to the job in their original containers, and to be Sherwin- Williams, ICI Coatings, Pittsburgh, or Pratt and Lambert.

Painter to mix samples of stains and colors and have Architect's approval before applying. All surfaces to receive paint, varnish, etc., shall be clean, smooth, free from dust, scratches, and to be thoroughly dry before applying paint.

The edges including the top and bottom edges of all doors which paint at the job site shall be finished as called for, and shall be touched up after the carpenter has made the final adjustments.

No paint shall be applied to wet or damp surfaces, nor shall any paint be applied to any surface when the temperature is below 50 degrees F.

All painting and decorating to be done by experienced workmen, and the finished work shall be free from runs, sags, scratches, and brush marks, and shall be uniform in color.

Application of a paint by spray not allowed other than glaze or multicolor coats as called for. All

wood and trim to be painted by brush only.

9E-04. APPLICATION:

- A. No coat shall be applied until the preceding one is thoroughly dry, and no paint shall be applied when temperature is 50 degrees F., or below, or when surfaces are damp. All paint shall be evenly spread and well brushed or sprayed as noted, or so as to accomplish best results. All paints, stains, etc., shall be mixed and applied according to manufacturer's directions, and each coat shall be sanded as required before the succeeding coat is applied.
- B. All raw spots of wood frames, interior millwork, to be primed at mill shall be touched up with similar material immediately after being placed. All knots, sap, and pitch streaks shall be brush coated with shellac before priming coat is applied. Prime all wood which is to be covered with metal unless same has been treated with wood preserver.
- C. Concrete masonry walls where called for to be painted shall be first examined for excess mortar, pointing up of joints, etc.
- D. All rust spots, scratches, blemishes, etc., on metal door frames and exposed metal work through the building, shall be worked to the base metal with steel wool, the spots primed, and when dry.
- E. Natural finish wood doors surfaces to be sanded with #320 wet or dry paper and rubbed with 4/0 steel wool between each coat.
- F. Epoxy Coating Finish: Where called for on the finish schedule, epoxy coating shall be as per Paragraph 16-11, this section.

9E-05. PUTTYING:

After the priming coat has been applied, all nail holes and voids of any kind are to be puttied flush with the surfaces. Excess putty shall be removed from the surfaces before succeeding coats of paint are applied.

9E-06. EXTERIOR PAINTING:

- A. All exposed metal, trim, frames, doors, miscellaneous steel and iron, galvanized iron:
 - 1. One Coat Primer: ICI Devoe Coatings DevGuard 4160 Multi-Purpose Tank and Structural Primer or one coat of Sherwin Williams Kerm Kromik Metal Primer and one coat of Sherwin Williams Galvite for Galvanized Irons.
 - 2. Two Coats Finish: ICI Devoe Coatings DevGuard 4308 Alkyd Gloss Enamel. Or two coats of Sherwin Williams Industrial Enamel B-54.
- B. All exposed wood and wood trim:

1. One Coat Primer: ICI Ultra-Hide Durus 2110 Exterior Alkyd Primecoat or one coat of Sherwin Williams A-100 Primer.
 2. Two Coats Finish: ICI Dulux Professional 2402 Exterior 100% Acrylic Satin Finish or Sherwin Williams K33W100 Satin Latex House.
- C. Exposed concrete block, concrete, and cement stucco:
1. One Coat Primer: (for concrete block only) ICI Ultra-Hide 3010-1200, Interior Exterior Vinyl Acrylic Block Filler or Sherwin Williams Heavy Duty Acrylic Block Filler B42W46.
 2. Two Coats Finish: ICI Dulux Professional 2402 Exterior 100% Acrylic Satin Finish or Sherwin Williams A24W351 Satin Latex House Paint.

9E-07. INTERIOR PAINTING:

- A. Exposed Iron and Steel Metals:
1. One Coat Primer: ICI Ultra-Hide 1120-1200 Oil / Alkyd Interior Enamel Undercoater or Sherwin Williams Kem Kromik Metal Primer.
 2. Two Coats Finish: ICI Ultra-Hide 1416 Latex Semi-Gloss Interior Wall and Trim Enamel or two coats Sherwin Williams Promar 200 Latex Semi-Gloss Enamel.
- B. Wood Trim (other than natural finish):
1. One Coat Primer: ICI Ultra-Hide 1120-1200 Oil / Alkyd Interior Enamel Undercoater or Sherwin Williams Classic Wall and Wood Primer B28-W101.
 2. Two Coats Finish: ICI Ultra-Hide 1416 Latex Semi-Gloss Interior Wall and Trim Enamel or Sherwin Williams Promar B-31 200 Semi-Gloss.
- C. Sheetrock Walls:
1. One Coat Primer: ICI Ultra-Hide 1030-1200 PVA Interior Primer Sealer or Sherwin Williams Promar 200 Series B-28.
 2. Two Coats Finish: ICI Ultra-Hide 1412 Latex Eggshell Interior Wall and Trim or Sherwin Williams Promar 200 Latex Semi-Gloss Enamel B-31.
- D. Exposed Masonry Block:
1. One Coat Primer: ICI Ultra-Hide 3010-1200 Interior / Exterior Vinyl Acrylic Blockfiller or Sherwin Williams Heavy Duty Acrylic Block Filler B42W46.
 2. Two Coats Finish: ICI Ultra-Hide 1412 Latex Eggshell Interior Wall and Trim

Enamel or Sherwin Williams Promar 200 Latex Semi-Gloss Enamel B-31.

- E. Epoxy Coating Finish: Where called for on the finish schedule, epoxy coating shall be as per Paragraph 16-11, this section.

9E-08. NATURAL FINISH:

- A. Where selected or called for on wood trim or doors or millwork items:

1. One coat of Lacquer Sealer and two coats of Gloss Lacquer or two coats of ICI Woodpride 1902 Interior Polyurethane High Gloss Varnish.

9E-09. STAINED FINISH:

- A. Where selected or called for on wood trim or wood doors or millwork items:

1. One Coat: ICI Woodpride 1900 Interior Oil Wood Finishing Stain or one coat of Olympic Clear Interior Stain.
2. One Coat: Lacquer Sealer or Sanding Sealer Well Sanded.
3. Two Coats: ICI Woodpride 1902 Interior Polyurethane High Gloss Varnish or two coats of Gloss Lacquer.

9E-10. SEALED CONCRETE FLOORS:

- A. Where called for on the drawings and finish schedule concrete floors shall be painted with H&C shield plus paint as manufactured by the Sherwin-Williams Company Cleveland, Ohio. (Technical Service Phone - 1-800/867-8246) or two coats of Anvil Concrete 1900 Siliconized Acrylic Concrete Stain.

- B. Concrete floor areas to receive paint shall be at least 45 days old, shall be clean and completely free of all grease, oil, loose or chalking paint, chalking concrete, dirt, etc.

Floor areas to be first cleaned with detergent and degreaser and thoroughly rinsed.

- C. Apply first coat of paint, let dry two (2) hours and apply 2nd coat. Paint maybe applied by brush, roller, or airless sprayer.

Do not apply in temperature below 50 degrees F or above 90 degrees F.

- D. Color to be selected by Architect.

9E-11. EPOXY COATING FINISH: N.A.

9E-12. SANDING AND FINISHING:

It will be the responsibility of the painting contractor to hand sand all surfaces to be painted and otherwise prepare them to provide a smooth finish paint job. All corners to be "eased", nail holes filled and painted surfaces prepared and approved after prime coat is applied. The second coat of paint must be completed and approved before final coat is started in any area. Repainting of any area required because of poor coverage, sags, voids, poorly prepared surfaces, etc., will require the repainting of the entire wall area. No patch painting will be accepted.

9E-13. APPLICATION OF COATS:

Work shall be limited to specific areas of construction to facilitate inspection and progress, and no succeeding coat will be applied in any area until the prime coat or first coat has been inspected and approved for the entire area.

Prime coat will be white. Second coat tinted toward color, and final coat from can in color selected.

9E-14. SUBMITTAL:

Painting contractor to submit technical information for the various types of paint used along with color sample box for color selection.

9E-15. GUARANTEE:

Painting contractor shall guarantee in writing his material and application for a period of one year from date of acceptance of building.

END OF SECTION.

SECTION 10A

MISCELLANEOUS SPECIALTIES

10A-01. **GENERAL CONDITIONS:**

The General Conditions, Division II, Sections E and F of these specifications shall apply to and form a part of this Section as if written in full herein.

10A-02. **SCOPE:**

Work under this heading includes necessary labor and materials required to install items listed in this Section or shown on the contract drawings.

10A-03. **ACCESS PANELS AND DOORS:**

Access panels for access to mechanical or electrical items shall be furnished to the general contractor by the respective subcontractor and installation shall be by the General Contractor.

All other areas which require access, access panels shall be furnished and installed by the General Contractor. Doors shall be suitable for wall or ceiling finish involved. Opening size shall be as required or as indicated and fire rated where rated walls or ceilings are penetrated. Units shall be equal to those manufactured by Milcor, Philip Carey, Zurn, or other approved equal.

10A-04. **PAIRED OPERABLE PARTITION:** N.A.

10A-05. **ALUMINUM LETTERS:** N.A.

10A-06. **ALUMINUM PLAQUE:** N.A.

10A-07. **ALUMINUM SHIPS LADDER:** N.A.

10A-07. **ALUMINUM THRESHOLDS:**

See Finish Hardware Section, these specifications. All thresholds to be set in full bed of mastic.

10A-08. **ALUMINUM & STEEL MISCELLANEOUS SHAPES:**

Furnish and install all aluminum or steel angles, channels, break metal shapes, in sizes and shapes and at locations as shown on drawings, or as required for support, bracing, anchoring, etc. of incidental items whether shown or not.

10A-09. BATHROOM ACCESSORIES:

Furnish and install the toilet room accessories in locations and types as follows:

1. Surface Mounted Paper Towel Dispenser - Bobrick Model 26-2, Stainless Steel.
 - a. One at Breakroom 109
 - b. One at Custodial room 112
 - c. One at Men's Toilet Room 118
 - d. One at Women's Toilet Room 119
 - e. One at Shop Toilet Room 120
2. Mirrors – Bradley Model 780, ¾" x ¾" Satin Finish Stainless Steel Frame all welded construction. 18-gauge wall hanger with theft resistant mounting bracket. 18" x 24" or sizes as shown on interior elevations / drawings.
 - a. One at Men's Toilet Room 118
 - b. One at Women's Toilet Room 119
 - c. One at Shop Toilet Room 120
3. Toilet Tissue Holder – Bradley Model 5402 Surface Mounted, fabricated from 304 Stainless Steel
 - a. One at Men's Toilet Room 118
 - b. One at Women's Toilet Room 119
 - c. One at Shop Toilet Room 120
4. Grab Bars - Bradley 1 ½ diameter (outside) Stainless Steel Series 812, sanitary safe gray finish 059 configuration and 01 configuration grab bar with concealed mounting.
 - a. One set at Men's Toilet Room 118
 - b. One set at Women's Toilet Room 119
 - c. One set at Shop Toilet Room 120
5. Soap Dispenser – Bobrick Model #B-824 counter mounted battery operated, automatic to fill bulk foam Soap Dispenser
 - a. One at Breakroom 109
 - b. One at Men's Toilet Room 118
 - c. One at Women's Toilet Room 119
 - d. One at Shop Toilet Room 120

10A-10. CHAIN LINK FENCE:

- A. Furnish and install at locations shown on the drawings, vinyl coated chain link fence. Height of fence and size of access gate shall be as shown on drawings.
- B. All materials for permanent fence shall be new. Fabric to be vinyl covered No. 9 gauge heavy zinc coated or hot galvanized by hot dip process after weaving. Fabric to be 2" chain link diamond mesh.

Line posts and end posts shall be 2" o.d., .140 wall, 2.72 LBS./FT. Maximum distance between post shall be 6'-0".

Top rail 1-5/8" o.d., 2.27 LBS./FT.

Tension wire No. 7 gauge.

Gate frames of 1-5/8" o.d., 2.27 LBS./FT.

- C. Methods of Construction: All posts and fabric shall be installed in accordance with the manufacturer's recommendations and as shown on the plans. Post spacing shall not exceed six (6') feet. Posts shall be set in concrete to a depth of 24". Minimum hole size shall not be less than 4 times the diameter of the post.

All materials and workmanship shall be first-class in every respect and shall conform to the specifications.

Provide caps on all posts and provide all accessories to make for completion installation.

- D. **Furnish shop drawings showing size, gauges, etc., of materials and description of construction for review and approval.**

- E. See supplementary and special conditions for temporary construction fencing.

10A-11. FIRE EXTINGUISHERS:

Furnish and install at the following locations, 10 lb. capacity fire extinguishers equal to "J L Industries Cosmic 10E A B C with U.L. rating 4A-60BC.

- a. One (1) at Work Area #103 near Door #102
- b. One (1) at Corridor #117 near Door #110A
- c. One (1) at Corridor #117 near Door #116
- d. Three (3) at Hangar #121, One (1) each door 121A, 121B, and 121C

Provide complete with metal hanger. The exact location will be as directed by Architect. Mounting height to be so top of extinguisher not more than 5'-0" A.F.F. Prior to final inspection, each extinguisher shall be inspected by the local fire inspector and tagged with inspection sticker showing the unit fully charged, date, and signature of the inspector.

10A-12. HANDRAILS/ GUARDRAILS: See drawings.

10A-13. HAT CHANNELS:

Furnish and install 1 ½" and ¾" galvanized hat channels for framing and installation of metal fascia and metal siding panels as shown and noted on the drawings. Light gauge framing for installation of fascia system shall be as shown on the drawings and specified in Section 11 of these specifications.

10A-14. CORRIDOR LOCKERS: N.A.

10A-15. P.E. ATHLETIC LOCKERS: N.A.

- 10A-16. ATHLETIC LOCKERS: N.A.
- 10A-17. MARKER BOARDS AND TACK BOARDS: N.A.
- 10A-18. MOP HOLDERS: N.A.
- 10A-19. PRECAST CONCRETE SILLS / WALL CAPS: N.A.

10A-20. SIGNAGE:

- A. Furnish and install plastic room signs as indicated on the door schedule. Signs shall be equal to Best Manufacturing Sign Systems, Montrose, Colorado; (303) 249-0223.
- B. Signs shall be 6 x 6 x ¼ MP and shall contain room number, room name, and raised braille copy. Numbers and names shall be engraved. All signs are to be ADA-compliant.

Type style shall be Helvetica Medium, and the finish of the background shall be non-glare. Colors of letters and background will be as selected by Architect.

Signs for restrooms shall have separate integral handicapped pictorial insignia.

The Architect will furnish room numbers and names.

- C. Install door signs 60" A.F.F., to the centerline of the sign, on the wall adjacent to the latch side of the door. The signs are to be installed with stainless steel screws.
- D. See mechanical and electrical drawings and specifications for engraved signs located at exhaust fan switches and emergency cut-offs. Signs to be red background, white letters. Signs to be installed for gas, water, electrical emergency cut off and for exhaust fans.
- E. Furnish shop drawings for approval and color samples for color selection.

- 10A-21. SOLID PLASTIC TOILET PARTITIONS: N.A.

END OF SECTION

SECTION 21 00 00 - FIRE PROTECTION

GENERAL

1.1 RELATED DOCUMENTS:

a. Basic Requirements: Provisions of Section 23 05 01, BASIC MECHANICAL REQUIREMENTS, are a part of this Section.

1.2 SUMMARY:

a. General: Provide the fire protection systems indicated on the drawings and within this specification section.

1.3 SUBMITTALS:

a. General: Include the following data:

b. Manufacturers Literature:

1. Dimensional outline drawing and verification of UL/FM approval for the following list of equipment:

- a) Each different type of valve.
- b) Each different type of piping hanger, supports, and sleeves.
- c) Piping and fittings.
- d) Firestopping.

c. Installation Instructions:

1. Manufacturer's printed instructions for the installation of sprinkler system items including copies shipped with the equipment.

d. Maintenance Instructions:

- 1. Test procedures and frequency of testing required for each component per manufacturer's recommendations.
- 2. Instructions to the Owner's designated employees on the operation of the entire system.

e. Piping Shop Drawings: Submit 1/4" scale piping shop drawings as prescribed in Section 23 05 01 and as required by codes.

1.4 APPLICABLE STANDARDS

a. General: All equipment, material, accessories, methods of construction and reinforcement, finish quality, workmanship and installation shall be in compliance with the paragraph entitled "Code Compliance" in Section 23 05 01.

b. NFPA - Fire Sprinkler System: The fire sprinkler protection systems installation, flushing

and testing shall comply with the requirements of NFPA 13, 24, and 25.

c. Pipe Thread Pattern: All threads shall be in accordance with local fire department specifications and NFPA.

d. UL/FM Approval: All equipment, valves, couplings, hangers and devices shall be approved by Underwriters' Laboratory (UL) and Factory Mutual (FM) for use in fire protection service.

e. Florida Building Code: 2020.

1.5 QUALITY ASSURANCE

a. Licensure: The fire protection systems shall be installed by a State Certified Fire Protection Contractor.

PRODUCTS

2.1 MANUFACTURER

a. General: Refer to Section 23 05 01.

b. Single Manufacturer: All items of a similar type shall be by the same manufacturer.

2.2 PIPE AND FITTINGS

a. General: Only the following materials designed for 175 psig CWP shall be used for fire protection piping unless specifically indicated otherwise. All piping materials shall have a corrosion resistance rating (CCR) of 1.0 or greater.

b. Pipe: 2-1/2 inch and larger pipe shall be black steel with roll-grooved or welded joints, Schedule 40, ASTM A-135.

c. Fittings: 2-1/2" and larger pipe shall be joined by rolled groove couplings or welded fittings only.

d. Corrosion Protection: All black steel pipe and fittings exposed to the exterior, moisture or corrosive fumes shall have a protective coating, such as factory hot-dipped galvanization; galvanized painting of piping is prohibited.

e. Flanges: Flanged fittings shall be threaded or welded, cast iron or steel, short body, Class 125. Gaskets shall be full face 1/8-inch minimum thickness red sheet rubber. Flange bolts shall be hexagon head machine bolts with heavy semi-finished hexagon head nuts, cadmium plated, having dimensions in accordance with ANSI B18.2. Grooved flanges shall not be permitted. Flange gaskets for dry pipe systems shall be made of material specifically listed for air service.

2.2 VALVES

a. Gate Type Isolation, 2-1/2 Inch and Larger: Isolation valves 2-1/2 inch and larger shall be gate valves with open screw and yoke. Valve shall have cast iron body with the valve size,

pressure rating, manufacturer, and "UL" and "FM" cast into the body. Valve shall have bronze or cast iron double disc and wedge, cast iron handwheel, bolted cast iron bonnet, non-re-lubricatable bronze stem with O-ring seals, and corrosion inhibiting asphalt varnish finish. Valve shall have 175 psig CWP working pressure, 350 psig test pressure, flanged connections, and shall be provided with an integral tamper switch.

1. Acceptable Manufacturers:

- a) Stockham**
- b) Mueller**
- c) Crane**
- d) Nibco**

b. Butterfly Type Isolation, 2-1/2 Inch and Larger: Isolation valves 2-1/2 inch and larger shall be cast iron body butterfly valves with the valve size, pressure rating, manufacturer and "UL" and "FM" cast into the body. Valve shall have bronze or cast iron disc, neoprene disc liner, cast iron handwheel with disc position indicator, integral tamper switch, 175 psig CWP working pressure, 350 psig CWP test pressure, and flanged or grooved connections.

1. Acceptable Manufacturers:

- a) Victaulic Series 708**
- b) Grinnell 8000 FP**
- c) Central ModelBFV**

c. Check Valve: Check valves shall be horizontal swing type rated for 175 psig CWP working pressure and 350 psig test pressure. Check valves shall have cast iron body with the valve size, "UL", "FM" and flow directional arrow cast into the body; bronze disc ring with cast iron disc; bronze hinge and hinge plug; malleable iron clapper arm; and bolted cast iron cover. Provide factory painted or hot-dipped galvanized finish.

1. Acceptable Manufacturers:

a) Flanged Connection:

- 1) Stockham**
- 2) Mueller**
- 3) Viking**

b) Grooved Connection:

- 1) Reliable**
- 2) Grinnell**
- 3) Viking**

d. Detector Check Valve: Water leak/metering detector check valves shall comply with the requirements of check valves herein, except that the seat ring shall be rubber and the valve body shall have tappings to allow installation of a water meter. Provide a factory-assembled water meter and trim assembly consisting of a pre-formed copper tubing bypass, brass fittings, angle stop and integral dual check valves.

e. Indicator Valve: Indicator valves shall be gate valve with non-rising bronze stem. Valve shall have cast iron body with the valve size, pressure rating, manufacturer, and "UL" and "FM" cast into the body. Valve shall have cast iron double disc and wedge, bronze seat ring, square cast iron operating nut compatible with the indicator socket, bolted cast iron bonnet, cast iron post indicator valve stuffing box with fiber gasket and rubber O-rings, cast iron indicator post flange, and asphalt varnish finish. Valve shall have 175 psig CWP working pressure, 350 psig test pressure, and flanged connections.

1. Acceptable Manufacturers:

- a) Mueller
- b) Viking
- c) Stockham

EXECUTION

3.1 INSTALLATION

a. Hangers: Pipe hangers on 4 inch and larger piping shall be clevis-type only. All hanger spacing shall comply with the requirements of NFPA-13.

b. Flushing: The entire system shall be flushed with clean water to remove debris resulting from installation. Flush through a burlap bag to retain debris for examination.

3.2 HYDROSTATIC TESTS

a. General: Above ground and below ground piping systems shall be hydrostatically tested at not less than 200 psi pressure, or at 50 psi in excess of the maximum pressure, whichever is greater, for a period of 2 hours. The test pressure shall be read from a gauge located at the low elevation point of the individual system or portion of the system being tested. The sprinkler piping shall not have leakage exceeding the amounts specified in NFPA 24. Leakage quantities shall be determined by pumping at the specified test pressure from a calibrated container. Repair leaking joints and retest as necessary until all systems have been tested. Test the piping between the check valve in the fire department inlet pipe and the outside connection the same as the balance of the system.

b. Test Blank: Test blanks (blind flanges) used shall be the self-indicating type, with red painted lugs protruding beyond the flange to clearly indicate their presence. Number all test blanks to assure removal after the testing is completed.

END OF SECTION 21 00 00

SECTION 22 00 00 COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

- a. This Section includes the following:
1. Piping materials and installation instructions common to most piping systems.
 2. Transition fittings.
 3. Dielectric fittings.
 4. Mechanical sleeve seals.
 5. Sleeves.
 6. Escutcheons.
 7. Grout.
 8. Equipment installation requirements common to equipment sections.
 9. Painting and finishing.
 10. Concrete bases.
 11. Supports and anchorages.

1.2 DEFINITIONS

- a. **Finished Spaces:** Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- b. **Exposed, Interior Installations:** Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- c. **Exposed, Exterior Installations:** Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- d. **Concealed, Interior Installations:** Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- e. **Concealed, Exterior Installations:** Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

- f. The following are industry abbreviations for plastic materials:
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.
 - 2. PVC: Polyvinyl chloride plastic.
- g. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.3 SUBMITTALS

- a. Product Data: For the following:
 - 1. Transition fittings.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Escutcheons.
- b. Welding certificates.

1.4 QUALITY ASSURANCE

- a. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- b. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- c. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- a. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

b. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.6 COORDINATION

a. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.

b. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

c. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

a. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

a. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

b. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

a. Refer to individual Division 22 piping Sections for special joining materials not listed below.

b. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a) Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.

b) Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

c. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

d. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

e. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

f. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

g. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

h. Solvent Cements for Joining Plastic Piping:

1. CPVC Piping: ASTM F 493.

2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

3. PVC to ABS Piping Transition: ASTM D 3138.

2.4 TRANSITION FITTINGS

a. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

1. Manufacturers:

a) Cascade Waterworks Mfg. Co.

b) Dresser Industries, Inc.; DMD Div.

c) Ford Meter Box Company, Incorporated (The); Pipe Products Div.

d) JCM Industries.

e) Smith-Blair, Inc.

f) Viking Johnson.

2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.

3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.

4. Aboveground Pressure Piping: Pipe fitting.

b. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers: Eslon Thermoplastics.

c. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers: Thompson Plastics, Inc.

d. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

1. Manufacturers:

a) NIBCO INC.

b) NIBCO, Inc.; Chemtrol Div.

e. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

1. Manufacturers:

a) Cascade Waterworks Mfg. Co.

b) Fernco, Inc.

c) Mission Rubber Company.

d) Plastic Oddities, Inc.

2.5 DIELECTRIC FITTINGS

a. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

b. Insulating Material: Suitable for system fluid, pressure, and temperature.

c. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

1. Manufacturers:

a) Capitol Manufacturing Co.

b) Central Plastics Company.

c) Eclipse, Inc.

d) Epco Sales, Inc.

e) Hart Industries, International, Inc.

f) Watts Industries, Inc.; Water Products Div.

g) Zurn Industries, Inc.; Wilkins Div.

d. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

1. Manufacturers:

a) Capitol Manufacturing Co.

b) Central Plastics Company.

c) Epco Sales, Inc.

d) Watts Industries, Inc.; Water Products Div.

e. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Manufacturers:

e) Advance Products & Systems, Inc.

f) Calpico, Inc.

g) Central Plastics Company.

h) Pipeline Seal and Insulator, Inc.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

f. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:

i) Calpico, Inc.

j) Lochinvar Corp.

g. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:

k) Perfection Corp.

l) Precision Plumbing Products, Inc.

m) Sioux Chief Manufacturing Co., Inc.

- n) Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

a. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:

a) Advance Products & Systems, Inc.

b) Calpico, Inc.

c) Metraflex Co.

d) Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

3. Pressure Plates: Stainless steel Include two for each sealing element.

4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

a. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

b. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

c. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

d. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

e. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

f. PVC Pipe: ASTM D 1785, Schedule 40.

g. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.8 ESCUTCHEONS

a. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

- b.** One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- c.** One-Piece, Cast-Brass Type: With set screw.
 - 1.** Finish: Polished chrome-plated and rough brass.
- d.** Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1.** Finish: Polished chrome-plated and rough brass
- e.** One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- f.** Split-Plate, Stamped-Steel Type: With concealed exposed-rivet hinge, set screw or spring clips, and chrome-plated finish.
- g.** One-Piece, Floor-Plate Type: Cast-iron floor plate.
- h.** Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

- a.** Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1.** Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2.** Design Mix: 5000-psi, 28-day compressive strength.
 - 3.** Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- a.** Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- b.** Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- c.** Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- d.** Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

e. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

f. Install piping to permit valve servicing.

g. Install piping at indicated slopes.

h. Install piping free of sags and bends.

i. Install fittings for changes in direction and branch connections.

j. Install piping to allow application of insulation.

k. Select system components with pressure rating equal to or greater than system operating pressure.

l. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

a) **Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.**

b) **Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.**

c) **Insulated Piping: One-piece, stamped-steel type with spring clips.**

d) **Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.**

e) **Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.**

f) **Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.**

g) **Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.**

h) **Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.**

m. Sleeves are not required for core-drilled holes.

n. Permanent sleeves are not required for holes formed by removable PE sleeves.

o. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

p. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.
 - a) Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a) Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b) Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c) Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.

q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

r. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve.

Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

s. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations under Division 7 Section Firestopping.

t. Verify final equipment locations for roughing-in.

u. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

a. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

b. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

c. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

d. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

e. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

f. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

g. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

h. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

i. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.

2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Nonpressure Piping: Join according to ASTM D 2855.
5. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- j. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- k. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- l. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 1. Plain-End Pipe and Fittings: Use butt fusion.
 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.3 PIPING CONNECTIONS

- a. Make connections according to the following, unless otherwise indicated:
 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- a. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- b. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- c. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- d. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

a. Painting of mechanical systems, equipment, and components is specified in Division 9 Sections

b. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

a. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section 033000 - Cast-in-Place.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

a. Refer to Division 5 Section "Metal Fabrications" for structural steel.

b. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

c. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

a. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.

b. Clean surfaces that will come into contact with grout.

c. Provide forms as required for placement of grout.

- d. Avoid air entrapment during placement of grout.
- e. Place grout, completely filling equipment bases.
- f. Place grout on concrete bases and provide smooth bearing surface for equipment.
- g. Place grout around anchors.
- h. Cure placed grout.

END OF SECTION 22 00 00

SECTION 22 05 00 PLUMBING PIPING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

a. Basic Requirements: Provisions of Section 23 05 01, BASIC MECHANICAL REQUIREMENTS, are a part of this Section.

1.2 SUMMARY

a. General: Provide domestic water piping, drainage waste and vent piping, and other plumbing piping and appurtenances as indicated.

1.3 SUBMITTALS

a. General: Provide shop drawing and manufacturer's data sheet for the following items:

1. Manufacturers Literature:

- a) Product data for recirculating hot water system.
- b) Product data for valve boxes and accessories.
- c) Complete list of all piping materials to be used in this section including valves, pipe schedules, pipe sizes and method of connection for each piping system.

2. Installation Instructions:

- a) Manufacturer's printed installation instructions for the non-recirculating hot water system.
- b) Assembly and installation instructions for valve boxes and extensions.

1.4 APPLICABLE STANDARDS

a. General: All equipment, material, accessories, methods of construction and reinforcement, finish quality, workmanship and installation shall be in compliance with the paragraph entitled "Code Compliance" in Section 23 05 01.

PART 2 - PRODUCTS

2.1 GENERAL

a. Application: The plumbing piping system shall only be of the materials indicated. Insulation shall comply with ASTM E-84 requirements with a flame spread rating not exceeding 25 and with a smoke developed/fuel contributed rating not exceeding 50.

b. Valves: All valves used in the plumbing piping shall be 125 psi SWP, 200 psi WOG.

c. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.

d. Install underground copper tube in PE encasement according to ASTM A 674 or AWWA C105.

2.2 DOMESTIC WATER PIPE

a. Above Ground:

1. Piping shall be copper tube, Type L, hard drawn.

b. Underground:

1. Type K soft drawn copper tubing without joints shall be used up to 4 inch diameter.

c. Fitting:

1. Copper Piping

a. Piping shall be wrought-copper, silver-soldered joint fittings and brazed joints.

2.3 SANITARY WASTE AND VENT PIPING

a. Above Ground:

1. Cast iron soil pipe, service weight, with bell and spigot joints.

2. Cast iron soil pipe, service weight, with no-hub couplings. For above ground installation only.

a) Shielded Couplings: ASTM C 1540 assembly of metal shield of housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

1) Heavy-duty, shielded, stainless-steel couplings: with stainless-steel bands and tightening devices, and ASTM C 564 rubber sleeve.

3. Copper: Type DWV with soldered joints.

4. Brass pipe or tube, chrome plated, where exposed in finished areas.

b. Below Ground:

1. Cast iron soil pipe, service weight, with bell and spigot joints.

2. PVC: PVC piping shall be permitted below grade only.

a) Type DWV, Schedule 40, ASTM D-1784 and D-2665.

3. Trench Drain Waste Piping

- a) Ductile iron centrifugally cast in accordance with AWWA C151. Push-on joints shall conform to AWWA C111. Gasket material shall be FKM with high chemical resistance to petroleum products (Jet A Fuel). Piping shall be provided with cement-mortar lining in accordance with ANSI/AWWA C104/A21.4.

2.4 CONDENSATE DRAIN PIPING

- a. General: Unless otherwise specifically noted condensate drain piping shall be the same as sanitary waste and vent piping.

2.5 THERMAL INSULATION

a. General: All insulation, jackets and adhesives used shall comply with the requirements of ASTM E-84 with a maximum flame spread rating of 25 and a maximum smoke developed/fuel contributed rating of 50. Insulation on piping exposed in boiler rooms, mechanical equipment rooms, air handling equipment rooms, etc. or exposed on the exterior of the building shall be cellular glass. Insulation for concealed piping shall be preformed pipe insulation as follows:

1. Exterior Domestic Cold Water:
 - a) Cellular Glass
2. Domestic Hot Water:
 - a) Fiberglass
3. Condensate Drain:
 - a) Elastomeric
4. Lavatory and Sink Drains:
 - a) Flexible closed cell insulation with 0.28k factor at 75°F mean temperature difference.

b. Thickness: The insulation thickness in inches shall be in accordance with the following table:

TABLE - PIPING INSULATION THICKNESS

Pipe Size, Inches	Up to 1	1-1/4 to 2	2-1/2 to 4	5 to 6	8 & Up
Cold Water	3/4	3/4	1	1	1
Hot Water	1	1	1-1/2	1-1/2	1-1/2
Condensate Drain	1/2	1/2	1/2	1/2	1/2
Lavatory Drain	—	1/2	—	—	—

* (Or manufacturer's minimum thickness based on the pipe size.)

A. Exposed: For piping, other than domestic cold water, exposed to the outdoor air or in an unconditioned crawl space or cellar area, increase insulation thickness by 1/2 inch.

B. Underground: Piping underground which is indicated to be insulated shall have cellular glass insulation.

e. Jackets:

1. Provide factory or field applied insulation jacket with compatible insulating cements, adhesives, mastics, and sealants, in accordance with the manufacturer's installation instructions for applicable indoor or exterior conditions. Jacket shall have vapor retarder film.
2. Exterior or indoor insulated piping subject to damage shall be provided with minimum 0.016" aluminum jacket with 3 mil vapor barrier. Secure jacket with stainless steel bands at 12" o.c. and at end joints.
3. Products: Subject to compliance with the requirements, provide insulation jackets and accessories manufactured by:
 - a) Foster Products Corporation
 - b) Childers Products
 - c) RPR Products

2.6 VALVES

a. 2 inch and smaller: Valves 2 inch and smaller shall be ball valves with bronze body and bronze trim, pressure-seal joint fittings.

b. 2-1/2 inch and larger, above ground: Valves 2-1/2 inch and larger shall be butterfly valves with flanged or welded joint connections, cast iron body with bronze trim.

c. Underground: Valves underground shall be butterfly (or ball - 2" and under)-type with cast iron body and bronze trim, flanged or welded connections, and non-rising stem with square wrench nut head.

d. Valve Box: Valve boxes for underground valves shall be cast iron construction with sufficient extension sections to extend flush to finished grade. Provide a cast iron lid and collar, with the word "water" cast into the lid. Provide a steel "T" handle valve operating wrench of sufficient length to operate the installed underground valve and provide a minimum 12 inches above finished grade; valve operating wrench shall be provided with a cast iron or steel socket compatible with the valve stem head.

PART 3 - EXECUTION

3.1 GENERAL

A. Location of Vents: Vents shall be offset as required to penetrate roofs at least 3 feet from the edges of the building, and 10 feet from any supply air intake or operable window or door.

B. Slope: Unless otherwise indicated, horizontal sanitary and storm piping 2-1/2 inches and smaller shall be sloped at a minimum of 1/4 inch per linear foot; piping 3 inches and larger shall be sloped a minimum of 1/8 inch per foot.

C. Vent Piping: Horizontal vent branches shall be kept above the highest fixture served by the vent branch in order to prevent the vent from being used as a waste line. Horizontal vent branches shall be sloped upward to prevent accumulating water or trapping.

D. Vent Connections: Vent piping connected to a horizontal pipe shall be taken from the centerline of the pipe. Vent piping shall rise at an angle not exceeding 45 degrees from vertical, to a point at least 6 inches above the flood rim of the highest attached fixture.

E. Vent Flashing: All vents extending through the roof and not otherwise indicated to have roof penetration seals or pitch pockets shall be flashed. Provide lead flashing with a minimum five pound per square foot density. Crimp the edge and flatten the flashing to maintain the maximum clear area of the pipe. Extend vents and piping through roof a minimum 8 inches above the finished roof surface unless otherwise indicated.

3.2 TESTING

a. Sanitary Piping:

- 1. Water Test:** A water test shall be applied to the sanitary and storm drainage systems. If applied to the entire system, all openings in the piping shall be tightly closed, except the highest opening, and the system filled with water to point of overflow. If the system is tested in sections, each opening shall be tightly plugged except the highest opening of the section under test, and each section shall be filled with water. In testing successive sections at least the upper 10 feet of the next preceding section shall be tested, so that no joint or pipe (except the uppermost 10 feet of the system) shall be submitted to a test of less than a 10 foot head of water. The water test shall last for at least 30 minutes. The system shall not experience a drop in water level; if a loss of water is noticed, the system shall be repaired and the test resumed until all sections of the piping are watertight.
- 2. Pneumatic Air Test:** An air test may be made by attaching an air compressor or testing apparatus to any opening and, after closing all other inlets and outlets to the system, forcing air into the system until there is a uniform gauge pressure of 5 psi. This pressure shall be held without introduction of additional air for a period of at least 30 minutes. If the test pressure drops, indicating a leak, the piping shall be repaired and the test resumed until all sections of the piping are air tight.

b. Condensate Drain Piping: Sanitary piping test shall be used for condensate drain piping.

c. Domestic Water Piping: Pressure testing and sterilization shall be performed as described in Section 23 21 13.

3.3 STERILIZATION

a. Domestic Water Piping:

1. Clean all water piping. Include storage vessels, and all components and devices in the piping system. Flush thoroughly, sterilize with chlorine solution for minimum 24 hours, then flush clean. Strength of chlorine solution and methods must comply with City Code and Health Authorities. At completion, there must be no discernible odor. Post warnings until sterilization is complete.

END OF SECTION 22 05 00

SECTION 22 05 19 METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- a. This Section includes the following meters and gages for mechanical systems:
 1. Thermometers.
 2. Gages.

1.2 DEFINITIONS

- a. CR: Chlorosulfonated polyethylene synthetic rubber.
- b. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.3 SUBMITTALS

- a. Product Data: For each type of product indicated; include performance curves.
- b. Shop Drawings: Schedule for thermometers, gages, flowmeters indicating manufacturer's number, scale range, and location for each.
- c. Product Certificates: For each type of thermometer, gage, and flowmeter signed by product manufacturer.
- d. Operation and Maintenance Data: For flowmeters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- a. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 LIQUID-IN-GLASS THERMOMETERS

- a. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a) Flo Fab Inc.
 - b) Miljoco Corporation.

- c) Palmer Wahl Instrumentation Group.
 - 2. Standard: ASME B40.200.
 - 3. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
 - 4. Case Form: Adjustable angle unless otherwise indicated.
 - 5. Tube: Glass with magnifying lens and blue organic liquid.
 - 6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
 - 7. Window: Glass.
 - 8. Stem: Aluminum and of length to suit installation.
 - a) Design for Thermowell Installation: Bare stem.
 - 9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
 - 10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.3 THERMOWELLS

- a. Manufacturers:
 - 1. AMETEK, Inc.; U.S. Gauge Div.
 - 2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
 - 3. Ernst Gage Co.
 - 4. Marsh Bellofram.
 - 5. Miljoco Corp.
 - 6. NANMAC Corporation.
- b. Manufacturers: Same as manufacturer of thermometer being used.
- c. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.4 PRESSURE GAGES

- a. Manufacturers:
 - 1. AMETEK, Inc.; U.S. Gauge Div.
 - 2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.

3. Ernst Gage Co.
 4. Eugene Ernst Products Co.
 5. KOBOLD Instruments, Inc.
 6. Marsh Bellofram.
- b. Direct-Mounting, Dial-Type Pressure Gages:** Indicating-dial type complying with ASME B40.100.
1. Case: Liquid-filled type, drawn steel or cast aluminum, 4-1/2-inch (114-mm) diameter.
 2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
 3. Pressure Connection: Brass, NPS 1/4 (DN 8), bottom-outlet type unless back-outlet type is indicated.
 4. Movement: Mechanical, with link to pressure element and connection to pointer.
 5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
 6. Pointer: Red or other dark-color metal.
 7. Window: Glass or plastic
 8. Ring: Brass.
 9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
 10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure (100 kPa of vacuum to 103 kPa of pressure).
 11. Range for Fluids under Pressure: Two times operating pressure.
- c. Pressure-Gage Fittings:**
1. Valves: NPS 1/4 (DN 8) brass or stainless-steel needle type.
 2. Syphons: NPS 1/4 (DN 8) coil of brass tubing with threaded ends.
 3. Snubbers: ASME B40.5, NPS 1/4 (DN 8) brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

- a. Install liquid-in-glass thermometers in the following locations:
 1. Outlet of each water heater.
- b. Install liquid-filled-case-type, vapor-actuated dial thermometers at suction and discharge of each pump.
- c. Provide the following temperature ranges for thermometers:

3.2 GAGE APPLICATIONS

- a. Install dry-case-type pressure gages for discharge of each pressure-reducing valve..
- b. Install liquid-filled-case-type pressure gages at suction and discharge of each pump.

3.3 INSTALLATIONS

- a. Install direct-mounting thermometers and adjust vertical and tilted positions.
- b. Install remote-mounting dial thermometers on panel, with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.
- c. Install thermowells with socket extending to center of pipe and in vertical position in piping tees where thermometers are indicated.
- d. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
- e. Install test plugs in tees in piping.
- f. Install flow indicators, in accessible positions for easy viewing, in piping systems.
- g. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters as prescribed by manufacturer's written instructions.
- h. Install flowmeter elements in accessible positions in piping systems.
- i. Install differential-pressure-type flowmeter elements with at least minimum straight lengths of pipe upstream and downstream from element as prescribed by manufacturer's written instructions.
- j. Install wafer-orifice flowmeter elements between pipe flanges.
- k. Install permanent indicators on walls or brackets in accessible and readable positions.
- l. Install connection fittings for attachment to portable indicators in accessible locations.

3.4 ADJUSTING

- a. Calibrate meters according to manufacturer's written instructions, after installation.
- b. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION 22 05 19

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SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

a. This Section includes the following hangers and supports for mechanical system piping and equipment:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fiberglass pipe hangers.
4. Metal framing systems.
5. Fiberglass strut systems.
6. Thermal-hanger shield inserts.
7. Fastener systems.
8. Pipe stands.
9. Pipe positioning systems.
10. Equipment supports.

b. Related Sections include the following:

1. Section 220529 – Metal Fabrications: For structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 21 – Fire-Suppression Piping: For pipe hangers for fire-protection piping.

1.2 DEFINITIONS

a. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry Inc.

b. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

a. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

b. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.4 SUBMITTALS

- a. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
 - 3. Powder-actuated fastener systems.
 - 4. Pipe positioning systems.
- b. Shop Drawings Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers. Include Product Data for components.
 - 2. Metal framing systems. Include Product Data for components.
 - 3. Fiberglass strut systems. Include Product Data for components.
 - 4. Pipe stands. Include Product Data for components.
 - 5. Equipment supports.
- c. Welding certificates.

1.5 QUALITY ASSURANCE

- a. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."
- b. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.2, "Structural Welding Code--Aluminum."
 - 3. AWS D1.3, "Structural Welding Code--Sheet Steel."
 - 4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 - 5. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- a. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

a. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

b. Manufacturers:

1. AAA Technology & Specialties Co., Inc.
2. Bergen-Power Pipe Supports.
3. B-Line Systems, Inc.; a division of Cooper Industries.
4. Carpenter & Paterson, Inc.
5. Empire Industries, Inc.
6. ERICO/Michigan Hanger Co.

c. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

d. Nonmetallic Coatings: Plastic coating, jacket, or liner.

e. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

a. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

a. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

b. Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
4. Power-Strut Div.; Tyco International, Ltd.
5. Thomas & Betts Corporation.

- 6. Tolco Inc.
- c. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- d. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

- a. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
- b. Manufacturers:
 - 1. Carpenter & Paterson, Inc.
 - 2. ERICO/Michigan Hanger Co.
 - 3. PHS Industries, Inc.
 - 4. Pipe Shields, Inc.
 - 5. Rilco Manufacturing Company, Inc.
 - 6. Value Engineered Products, Inc.
- c. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with vapor barrier.
- d. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass.
- e. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- f. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- g. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

- a. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:
 - a) Hilti, Inc.
 - b) ITW Ramset/Red Head.
 - c) Masterset Fastening Systems, Inc.

d) MKT Fastening, LLC.

e) Powers Fasteners.

b. Mechanical-Expansion Anchors: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:

a) B-Line Systems, Inc.; a division of Cooper Industries.

b) Empire Industries, Inc.

c) Hilti, Inc.

d) ITW Ramset/Red Head.

e) MKT Fastening, LLC.

f) Powers Fasteners.

2.7 PIPE STAND FABRICATION

a. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

b. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

1. Manufacturers:

a) ERICO/Michigan Hanger Co.

b) MIRO Industries.

c. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

1. Manufacturers:

a) MIRO Industries.

d. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.

1. Manufacturers:

a) ERICO/Michigan Hanger Co.

b) MIRO Industries.

c) Portable Pipe Hangers.

2. Base: Stainless steel
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

e. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.

1. Manufacturers:

a) Portable Pipe Hangers.

2. Bases: One or more plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

f. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.8 PIPE POSITIONING SYSTEMS

a. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.

b. Manufacturers:

1. C & S Mfg. Corp.
2. HOLDRITE Corp.; Hubbard Enterprises.
3. Samco Stamping, Inc.

2.9 EQUIPMENT SUPPORTS

a. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.10 MISCELLANEOUS MATERIALS

a. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

b. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

a. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

b. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

c. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

d. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

e. Use padded hangers for piping that is subject to scratching.

f. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
3. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
4. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
6. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

g. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.

2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

h. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

i. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

- 12. Welded-Steel Brackets:** For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a)** Light (MSS Type 31): 750 lb.
 - b)** Medium (MSS Type 32): 1500 lb.
 - c)** Heavy (MSS Type 33): 3000 lb.
 - 13. Side-Beam Brackets (MSS Type 34):** For sides of steel or wooden beams.
 - 14. Plate Lugs (MSS Type 57):** For attaching to steel beams if flexibility at beam is required.
 - 15. Horizontal Travelers (MSS Type 58):** For supporting piping systems subject to linear horizontal movement where headroom is limited.
- j. Saddles and Shields:** Unless otherwise indicated and except as specified in piping system Sections, install the following types:
- 1. Steel Pipe-Covering Protection Saddles (MSS Type 39):** To fill interior voids with insulation that matches adjoining insulation.
 - 2. Protection Shields (MSS Type 40):** Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 3. Thermal-Hanger Shield Inserts:** For supporting insulated pipe.
- k. Spring Hangers and Supports:** Unless otherwise indicated and except as specified in piping system Sections, install the following types:
- 1. Restraint-Control Devices (MSS Type 47):** Where indicated to control piping movement.
 - 2. Spring Cushions (MSS Type 48):** For light loads if vertical movement does not exceed 1-1/4 inches.
 - 3. Spring-Cushion Roll Hangers (MSS Type 49):** For equipping Type 41 roll hanger with springs.
 - 4. Spring Sway Braces (MSS Type 50):** To retard sway, shock, vibration, or thermal expansion in piping systems.
 - 5. Variable-Spring Hangers (MSS Type 51):** Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
 - 6. Variable-Spring Base Supports (MSS Type 52):** Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.

7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a) Horizontal (MSS Type 54): Mounted horizontally.
 - b) Vertical (MSS Type 55): Mounted vertically.
 - c) Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- I. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- m. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- n. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- o. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

- a. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- b. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- c. Fiberglass Pipe Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- d. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

- e. **Fiberglass Strut System Installation:** Arrange for grouping of parallel runs of piping and support together on field-assembled fiberglass struts.
- f. **Thermal-Hanger Shield Installation:** Install in pipe hanger or shield for insulated piping.
- g. **Fastener System Installation:**
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- h. **Pipe Stand Installation:**
 - 1. **Pipe Stand Types except Curb-Mounting Type:** Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2. **Curb-Mounting-Type Pipe Stands:** Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 7 Section "Roof Accessories" for curbs.
- i. **Pipe Positioning System Installation:** Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.
- j. **Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.**
- k. **Equipment Support Installation:** Fabricate from welded-structural-steel shapes.
- l. **Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.**
- m. **Install lateral bracing with pipe hangers and supports to prevent swaying.**
- n. **Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.**
- o. **Load Distribution:** Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- p. **Pipe Slopes:** Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

- q.** Insulated Piping: Comply with the following:
- 1.** Attach clamps and spacers to piping.
 - a)** Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b)** Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c)** Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
 - 2.** Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a)** Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3.** Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a)** Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4.** Shield Dimensions for Pipe: Not less than the following:
 - a)** NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b)** NPS 4: 12 inches long and 0.06 inch thick.
 - c)** NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - 5.** Insert Material: Length at least as long as protective shield.
 - 6.** Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- a.** Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- b.** Grouting: Place grout under supports for equipment and make smooth bearing surface.
- c.** Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- a.** Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

b. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

c. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

a. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

b. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches

3.6 PAINTING

a. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

b. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9

c. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 22 05 29

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SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- a. This Section includes the following mechanical identification materials and their installation:
 - 1. Equipment nameplates.
 - 2. Equipment markers.
 - 3. Equipment signs.
 - 4. Access panel and door markers.
 - 5. Pipe markers.
 - 6. Stencils.
 - 7. Valve tags

1.2 SUBMITTALS

- a. Product Data: For each type of product indicated.
- b. Samples: For color, letter style, and graphic representation required for each identification material and device.

1.3 QUALITY ASSURANCE

- a. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.4 COORDINATION

- a. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- b. Coordinate installation of identifying devices with location of access panels and doors.
- c. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

- a.** Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
 - 1.** Data:
 - a)** Manufacturer, product name, model number, and serial number.
 - b)** Capacity, operating and power characteristics, and essential data.
 - c)** Labels of tested compliances.
 - 2.** Location: Accessible and visible.
 - 3.** Fasteners: As required to mount on equipment.
- b.** Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
 - 1.** Terminology: Match schedules as closely as possible.
 - 2.** Data:
 - a)** Name and plan number.
 - b)** Equipment service.
 - c)** Design capacity.
 - d)** Other design parameters such as pressure drop, entering and leaving conditions, and speed.
 - 3.** Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.
- c.** Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
 - 1.** Data: Instructions for operation of equipment and for safety procedures.
 - 2.** Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
 - 3.** Thickness: 1/8 inch, unless otherwise indicated.
 - 4.** Thickness: 1/16 inch for units up to 20 sq. in. or 8 inches in length, and 1/8 inch for larger units.

5. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.
- d. Access Panel and Door Markers: 1/16-inch- thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.
 1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.
- e. Valve Tags:
 1. Indoor:
 - a) 19 gauge brass, 1-1/2 inch round, with 1/4 inch high black pipe service letter abbreviation above 1/2 inch high black valve number. Pipe service letter abbreviation shall be in accord with legend on drawings. Valve tag attachment shall be 4 ply 0.018 copper wire meter seal or #6 solid brass bead chain with locking link.
 2. Outdoor:
 - a) 19 gauge Type 304 stainless steel, 1-1/2" round, with 1/4 inch high pipe service abbreviation above 1/2 inch high black valve number. Pipe service letter abbreviation shall be in accord with legend on drawings. Color of valve tag shall match pipe marker color. Valve tag attachment shall be 4 ply 0.018 stainless wire meter seal or #6 Type 304 stainless steel bead chain with locking link.
 3. Valve Chart Frame: Self-closing, satin-finished, extruded aluminum with glass window, 8-1/2 inch by 11 inch chart size. Provide valve chart for each mechanical and custodial room. Valve chart shall indicate valve number, location, piping system and normal operating position. Valve chart shall be provided on laminated bond paper

2.2 PIPING IDENTIFICATION DEVICES

- a. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
 1. Colors: Comply with ASME A13.1, unless otherwise indicated.
 2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length
 3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
 4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.

5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- b. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.
- c. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.
- d. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.
- e. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.
 1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

2.3 STENCILS

- a. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door markers, equipment markers, equipment signs, and similar operational instructions.
 1. Stencil Material: Brass.
 2. Stencil Paint: Exterior, gloss, acrylic enamel black, unless otherwise indicated. Paint may be in pressurized spray-can form.
 3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1, unless otherwise indicated.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

- a. Products specified are for applications referenced in other Division 22 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

- a. Install and permanently fasten equipment nameplates on each major item of plumbing equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
 1. Pumps, compressors, and similar motor-driven units.
- b. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
 1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
 - b) Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - c) Meters, gages, thermometers, and similar units.
 - d) Pumps, compressors, and similar motor-driven units.
 - e) Tanks and pressure vessels.
 - f) Strainers, filters, and similar equipment.
- c. Stenciled Equipment Marker Option: Stenciled markers may be provided instead of laminated-plastic equipment markers, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.
- d. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.
 1. Identify mechanical equipment with equipment markers in the following color codes:
 - g) Green: For cooling equipment and components.
 - h) Yellow: For heating equipment and components.
 - i) Orange: For combination cooling and heating equipment and components.

2. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
4. Include signs for the following general categories of equipment:
 - j) Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - k) Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - l) Tanks and pressure vessels.
 - m) Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
- e. Stenciled Equipment Sign Option: Stenciled signs may be provided instead of laminated-plastic equipment signs, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.
- f. Install access panel markers with screws on equipment access panels.

3.3 PIPING IDENTIFICATION

- a. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
 1. Pipes with OD, Including Insulation, Less Than 6 Inches: Pretensioned pipe markers. Use size to ensure a tight fit.
 2. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, 1-1/2 inches wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
 3. Pipes with OD, Including Insulation, 6 Inches and Larger: Shaped pipe markers. Use size to match pipe and secure with fasteners.
 4. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.

- b. Stenciled Pipe Marker Option: Stenciled markers may be provided instead of manufactured pipe markers, at Installer's option. Install stenciled pipe markers complying with ASME A13.1 on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- c. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and nonaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.
- d. Valve Tags:
 - 1. Valve tag description shall include system abbreviation as shown on plans and sequential numbering.
 - 2. Provide valve tags on all valves, exposed or concealed.
 - 3. Attach valve tag to stem of each valve.
 - 4. Provide a marker for each valve located above lift-out tile ceiling or hard ceiling with access panel as listed in section 2.1.D. All markers shall adhere to ceiling grid and have same data as the valve tag.

3.4 ADJUSTING

- a. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.5 CLEANING

- a. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION 22 05 53

SECTION 22 16 00 - COMMERCIAL GAS PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

a. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

a. Natural Gas (G) Piping

1.3 DEFINITIONS

a. The pipe sizes given in this document are nominal.

1.4 QUALITY ASSURANCE

a. All material provided under this section shall be standard catalogued products of recognized manufacturers regularly engaged in the production of such products, and shall be of the manufacturer's most recent design that is in regular production.

b. Each item provided under this section shall meet the requirements for that item as installed and used, in accordance with the following standards:

1. All other metallic piping - ASME/ANSI B31.1

c. Each piping system shall be in accordance with the system design pressures shown in paragraph 2.1 - Materials, this specification section.

d. All materials provided under this section shall be new, except where the specifications and/or drawings permit the reuse of certain existing materials.

1.5 SUBMITTALS

a. All submittals shall be made in accordance with Division 01.

b. Submit a list identifying the specific type of material that will be used for each piping system. Include pipe, pipefittings, valves and joints. Include the basic designation of the publication applicable for each type of material and method.

PART 2 – PRODUCTS

2.1 MATERIALS

- a. Natural Gas (G) Piping:
System Design Pressure: 20 psig.
 - 1. Piping: Schedule 40 carbon steel, seamless; ASTM A-53, Grade A or B.
 - 2. Piping: Copper type K or L only. Pipe conforming to ASME B16.18 and B16.22.
 - 3. Direct buried pipe shall be coated with an extrusion applied, fusion bonded epoxy-coated jacket, 0.040" minimum thickness. Equal to 3M-Skotchkote™.
 - 4. Pipe Fittings 2" and smaller: 150 lb. rated malleable iron, threaded, type, ASTM A-197.
 - 5. Pipe fittings 2-1/2" and larger: Schedule 40 carbon steel, butt weld type, ASTM A-234-WPB.
 - 6. Vent cap to be a mushroom type to match piping and fittings and shall be complete with insect screen.
 - 7. Underground gas piping exterior to buildings shall be polyethylene pipe complying with ASTM D2513, SDR II. Fittings shall be socket fusion type meeting ASTM D2683 or butt-fusion type complying with ASTM D3261. Provide factory fabricated transition service-line risers.

PART 3 - EXECUTION

3.1 INSTALLATION

- a. General:
 - 1. Furnish and install piping, fittings and appurtenances required to complete the piping systems shown on the drawings. Elbows shall be long radius type. Tees may not be field fabricated.
 - 2. Run piping to true alignment, generally parallel or perpendicular to building walls, floors and ceilings, and with uniform grades and spacing, so as to present a neat and workmanlike appearance.
 - 3. Care shall be paid to the exact locations of piping with respect to equipment, ducts, conduits, slabs, beams, lighting fixtures, columns, ceiling suspension systems, etc. to provide maximum access to mechanical and electrical equipment in the building. Close coordination and cooperation shall be exercised with other trades in locating the piping in the best interests of the Owner. The drawings and specifications covering other work to be done in the building shall be carefully studied and arrangements made to avoid conflict.
 - 4. Not all necessary pipe offsets are indicated on the drawings because of the small scale. The various runs of piping to be installed shall be studied and adjustments made in exact routings as may be required for proper installation.
 - 5. Conflicts arising during the erection of piping shall be brought to the attention of the Owner's Representative. No improvising or field changes will be permitted without the approval of the Owner's Representative.
 - 6. Use full lengths of pipe wherever possible. Short lengths of pipe with couplings will not be permitted. Cut to exact measurement and install without forcing or spring unless otherwise shown on the drawings or specified.

7. Avoid tool marks and unnecessary pipe threads. Burrs formed when cutting pipe shall be removed by reaming. Before installing any pipe, care shall be taken that the inside is thoroughly cleaned and free of cuttings and foreign matter. Measures shall be taken to preserve this cleanliness after erection.
8. Arrange pipe connections to valves and specialties so that there is clearance for easy removal of the valve or specialty from the line, and also for the removal of the valve bonnet and interior, and the specialty top and bottom and interior, except where otherwise approved by the Owner's Representative.
9. Erect piping in such a manner so as to obtain sufficient flexibility and to prevent excessive stresses in materials and excessive bending movements at joints or connections to equipment. Make allowances throughout for expansion and contraction of piping. Provide each riser and horizontal run of piping with expansion loops, expansion joints, or expansion compensators where indicated and required. Securely anchor and adequately guide pipe as required or where indicated to force expansion to the expansion device without bending, binding, or misalignment of pipe. Branch connections from mains to risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Where indicated, in lieu of expansion loops, expansion joints, or expansion compensators, horizontal runs of pipe shall be anchored at approximately midway of the run to force expansion, evenly divided, toward the mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining.
10. Installed piping shall not interfere with the operations or accessibility of doors or windows and shall not encroach on aisles, passageways and equipment, and shall not interfere with the servicing or maintenance of any equipment. Adjacent pipelines shall be grouped in the same horizontal or vertical plane.
11. Where lines are purposely pitched for drainage, an accurate grade shall be maintained. No lines shall be supported in such a manner as to permit deflection, due to gravity, sufficient to pocket the lines when full of liquid. Grade mains as indicated by arrows on the drawings and in accordance with gradient as indicated in attached Piping Schedule.
12. Use building steel wherever possible for supporting pipe hangers. Main structural steel shall not be drilled, cut or burned for hangers without the approval of the Owner's Representative. Expansion bolts shall be used only upon the approval of the Owner's Representative.
13. Install unions or flanges in piping connections to equipment, regulating valves, and wherever necessary to facilitate the dismantling of piping and/or removal of valves and other items requiring maintenance.
14. Avoid bushings. Reducing fittings shall be used wherever practical.
15. The drawings indicate the size of piping and connections, and if certain sizes are omitted or unclear, obtain additional information before proceeding.
16. The piping drawings have been worked out with a view to the most economical installation, taking into consideration accessibility and appearances, and the Contractor must follow the drawings accurately and if it is found impractical to install the work in accordance with the drawings and specifications, the Contractor shall notify the Owner's Representative before making any changes and get their approval or revised drawings before proceeding with the work. Verify all measurements on the job before cutting pipes or having piping fabricated, and be responsible for the correct location of all pipe connections, also check sizes and standard of outlets on the equipment, including the dimensions and drilling of flanges, etc.

b. Gas Systems Additional Requirements:

1. Installation shall be in accordance with Florida Building Code 7th Edition (2020) Fuel Gas, NFPA No. 54 and ANSI Z 223.1 unless specified otherwise herein.
2. Provide a capped 6" dirt leg at the base of main risers.
3. Valves in natural gas service shall be lubricated plug cocks.
4. Horizontal pipe shall slope upward, in the direction of flow, at not less than 1/4 inch in 15 feet.
5. Where piping is concealed, all plugged or capped openings shall be exposed and accessible. Bushings and unions shall not be used in concealed work.
6. Branch connections shall be made on the side or top of the main for both up-feed and down-feed applications.
7. Vent gas pressure regulator and safety shut-off reverse vent valve relief lines to outside the building individually. Relief lines from pressure switches may be combined in another line, or run separate, for venting to the outside.
8. After testing is completed, and before connecting any appliances, all piping shall be fully purged. Piping shall not be purged into the combustion chamber of an appliance. The open end of piping systems being purged shall not discharge into confined spaces or areas where there are ignition sources unless the safety precautions recommended in NFPA No. 54, or ANSI Z 223.1 are followed.
9. After the piping has been placed in operation, all equipment shall be purged and then placed in operation, as necessary.

3.2 TESTING OF PIPING SYSTEMS:

a. Each piping system, after erection, shall be subjected to a pressure test. The test requirements shall be as follows:

1. Gas Piping Systems shall be tested with air at not less than 25 PSIG for a period of not less than 15 minutes without showing any drop in pressure.
2. Leaks, if any, shall be located, repaired, and retested in accordance with the test method specified for the system in which the leaks are located.

b. Prior to testing a system, the Contractor shall provide the proper Building Official and the Owner's Representative with not less than 72 hours notice of the proposed test. The Contractor shall obtain approval of the test results. Where written approval is required, the Contractor shall obtain such written approval, and submit a copy of the approval.

c. Work requiring testing shall not be covered, or otherwise concealed, until testing is completed and approval is granted.

d. Work, or portions of work, that is altered in any way after testing and approval shall be retested, witnessed, and approval obtained.

e. Duration of tests, unless specified otherwise, shall be the time required to examine each joint in the system being tested.

f. During tests, isolate system components that have test pressures less than pressures

specified for system tests.

g. Use clean soapy water applied to exterior of joints to locate leaks in systems using compressed air, dry carbon dioxide, or nitrogen, under positive pressure as a test medium.

END OF SECTION 22 16 00

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SECTION 22 30 00 PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

a. Basic Requirements: Provisions of Section 23 05 01, BASIC MECHANICAL REQUIREMENTS, are a part of this Section.

1.2 SUMMARY

a. General: Provide plumbing equipment including piping, valves, overflow drain pans, relief valves, fitting and appurtenances.

1.3 SUBMITTALS

a. General: Provide shop drawings and manufacturer's data sheets for the following items:

1. Manufacturers Literature:

a) Dimensional outline drawing of each electric water heater showing the location of all connections and the wattage, voltage and phase.

1.4 APPLICABLE STANDARDS

a. General: All equipment, material, accessories, methods of construction and reinforcement, finish quality, workmanship and installation shall be in compliance Section 23 05 01.

b. Industry Standards: Where compliance with an industry, society or association standard is specified or indicated, certification of such compliance shall be submitted with the shop drawings.

c. ASHRAE Requirements: The heat loss through the domestic hot water heater exterior jacket, and the unit operating efficiency, shall meet ASHRAE Standard 90.1 requirements.

PART 2 - PRODUCTS

2.1 GENERAL

A. Manufacturers: Refer to Section 23 05 01.

2.2 ELECTRIC WATER HEATERS

a. Light Commercial:

1. Tank: Heater shall be constructed with steel tank constructed to 125 psi working pressure, 300 psi test pressure and lined with borosilicate glass bonded to tank. Glass lining to be baked at 1600 degrees F. to assure a molecular-interchange between tank and lining. Tank to be protected against electrolytic activity with replaceable factory installed anode rod and factory installed dielectric nipples.

2. Temperature Control: Water heater to be provided with fully adjustable temperature controls and automatic high limit control. Unit shall have ASME approved temperature and pressure relief valve properly sized for btu capacity of the unit installed.
3. Insulation: Water heater shall be insulated to ASHRAE 90.1 standards and jacketed with manufacturers standard heavy steel jacket.
4. Heating Element: Water heater shall also feature 98 percent efficient immersion type heating elements. Zinc plated copper sheathed elements shall be provided.
5. Relief valve: Provide ASME rated and UL listed temperature and pressure relief valve. Temperature setting shall be 210 degrees F. and the pressure setting shall be 125 psig unless otherwise indicated.
6. Drain: Provide storage tank drain and drain pan fabricated of minimum 18 gauge galvanized steel with a minimum lip of 1-1/2 inches, and provided with a drain connection piped to the nearest floor drain unless otherwise indicated.
7. Testing: All units to be UL tested and UL listed for service as a domestic water heater for voltage inputs as indicated on the drawings.
8. Warranty: Water heater shall carry a limited factory warranty of 3 years. Owner to be provided with copy of warranty and operations manuals as distributed by manufacturer.
9. Manufacturer:
 - a) A. O. Smith
 - b) State Industries
 - c) Rheem

2.3 CLOSE-COUPLED, IN-LINE SEALLESS CENTRIFUGAL PUMPS

Manufacturers:

- a) Armstrong Pumps Inc.
- b) Bell & Gossett Domestic Pump; ITT Industries.
- c) Grundfos Pumps Corp.
- d) Taco, Inc.

Description: Factory-assembled and -tested, single-stage, close-coupled, in-line, sealless centrifugal pumps.

- a) Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge-type unit with motor and impeller on common shaft and designed for installation with pump and motor shaft mounted horizontally.
- b) Casing: Bronze, with threaded companion-flange connections.
- c) Edit first subparagraph below if bronze or stainless-steel impeller is required.
- d) Impeller: Corrosion-resistant material.
- e) Motor: Single speed, unless otherwise indicated.
- f) Control: Aquastat thermostatic switch and programmable 24 hour clock/timer.

2.4 FLEXIBLE CONNECTORS

- a. Manufacturers:
 - a) Flexicraft Industries.
 - b) Hyspan Precision Products, Inc.
 - c) Metraflex, Inc.
 - d) Proco Products, Inc.
 - e) Tozen America Corporation.

f) Unaflex Inc.

Description: Corrugated, bronze inner tubing covered with bronze wire braid. Include copper tube ends or bronze flanged ends, braze-welded to tubing. Include 125-psig minimum working pressure rating and ends matching pump connections.

2.5 CONTROLS

- a.** Thermostats: Electric, adjustable for control of hot-water circulation pump.
 - a)** Type: Water-immersion temperature sensor, for installation in piping.
 - b)** Range: 65 to 200 deg F.
 - c)** Enclosure: NEMA 250, Type 4X.
 - d)** Operation of Pump: On or off.
 - e)** Transformer: Provide if required.
 - f)** Power Requirement: 120 V, ac.
 - g)** Settings: Start pump at 100 deg F and stop pump at HW loop temperature, as shown on the plans.
- b.** Hot Water Circulation Pump Control.
 - 1. Provide aquastat and timer for recirculation pump control. Adjust settings in accordance with tenant requirements.

PART 3 - EXECUTION

3.1 GENERAL

a. Installation: Install all equipment where indicated, in accordance with manufacturer's published installation instructions, with recommended clearances provided for service and maintenance. Equipment placement shall be essentially as shown on drawings: however, actual location shall be verified using field measurements and data relating to equipment actually approved for installation on this project.

3.2 WATER HEATERS

a. Piping: Provide shut-off valves on both the incoming cold water and leaving hot water supply piping. Heat trap shall be installed in the hot water supply piping.

b. Relief Valve Discharge: The discharge from the temperature/pressure relief valve shall be piped full-size separately to approved terminal as provided for safety pan drain terminals but in no case shall the discharge from a relief valve be trapped.

c. Vacuum Breaker: Cold water supply shall provided with a vacuum breaker.

d. Union Connections: Provide unions to facilitate replacement of the equipment.

e. Drain Pan: The water heater drain pan shall be drained by an indirect waste pipe no less than 1 inch in diameter or the diameter of the outlet of the required relief valve whichever is larger. The pan drain shall extend full-size and terminate over a suitably located indirect waste receptor,

floor drain or extend to the exterior of the building and terminate no less than 6 inch or more than 24 inch above grade.

f. Floor Mounted Water Heaters: All floor mounted water heaters shall have their drain pan set on a 4 inch high housekeeping pad. Refer to Section 23 05 03.

3.3 CIRCULATION PUMP INSTALLATION

- a. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
- b. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- c. Install in-line, sealless centrifugal pumps with motor and pump shafts horizontal.
- d. Install immersion-type thermostats in hot-water return piping.
- e. Install piping adjacent to pumps to allow service and maintenance.
- f. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles. Refer to Division 22 Section "Domestic Water Piping."
 - a) Install flexible connectors adjacent to pumps in suction and discharge piping of close-coupled, horizontally mounted, in-line centrifugal pumps.
 - b) Install shutoff valve and thermometer on suction side of each pump, and check and shutoff valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in Division 22 Section "General-Duty Valves for Plumbing Piping" and comply with requirements for strainers specified in Division 22 Section "Domestic Water Piping Specialties".
- g. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- h. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- i. Connect thermostats to pumps that they control.

3.4 CIRCULATION PUMP IDENTIFICATION

- a. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.5 CIRCULATION PUMP STARTUP SERVICE

- a. Perform startup service.
 - a) Complete installation and startup checks according to manufacturer's written instructions.
 - b) Clean strainers on suction piping.
 - c) Perform the following startup checks for each pump before starting:
 - a. Verify bearing lubrication.

- b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
- c. Verify that pump is rotating in the correct direction.
- d) Prime pump by opening suction valves and closing drains, and prepare pump for operation.
- e) Start motor.
- f) Open discharge valve slowly.
- g) Adjust temperature settings on thermostats.

3.6 CIRCULATION PUMP ADJUSTING

- a. Adjust domestic water pumps to function smoothly, and lubricate as recommended by manufacturer.
- b. Adjust initial temperature set points.
- c. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 22 30 00

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SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Basic Requirements: Provisions of Section 23 05 01, BASIC MECHANICAL REQUIREMENTS, are a part of this Section.

1.2 SUMMARY

A. General: Provide plumbing fixtures, traps, tailpieces, trim, devices and appurtenances as indicated.

1.3 SUBMITTALS

A. General: Provide shop drawings and manufacturer's data sheets for the following items:

1. Manufacturers Literature:

- a)** Dimensional outline drawing for each plumbing fixture including fittings and trim.
- b)** Outline drawings and data sheets for the following items of plumbing equipment:
 - 1)** Each type of floor drain or floor sink including trap guard.
 - 2)** Shower pan material.
 - 3)** Each cleanout and cleanout covers including wall access cover.
 - 4)** Water hammer arrester including capacity and pipe connection size.

2. Installation Instructions:

- a)** Manufacturer's printed installation instructions including copies shipped with each fixture.
- b)** Mounting templates for fixtures.
- c)** Pressure and fixture unit capacity for water hammer arresters.

3. Maintenance Instructions: Exploded parts list for each item.

1.4 APPLICABLE STANDARDS

A. General: All equipment, material, accessories, methods of construction and reinforcement, finish quality, workmanship and installation shall be in compliance with Section 15010.

b. Access for the Disabled: Fixtures indicated to provide disabled access shall be designed, manufactured and installed in accordance with ANSI 117.1.

c. ASSE: Fixtures and devices shall comply with the standards of the American Society of Sanitary Engineers, where required.

d. ADA: Fixtures, devices and installation clearances and heights shall comply with the requirements of the Americans with Disabilities Act (ADA).

e. PDI: Fixtures and devices shall comply with the standards of the Plumbing and Drainage Institute, where required.

PART 2 - PRODUCTS

2.1 GENERAL

A. Manufacturer: Refer to Section 23 05 01.

B. Material: Fixtures shall be white vitreous china unless otherwise indicated. Where enameled iron fixtures are specified, they shall be furnished with acid resisting enamel.

C. Quality: Plumbing fixtures shall be "First Quality" as defined and set forth in Commercial Standard CS77-28 as promulgated by the U.S. Department of Commerce. Fixture fittings shall comply with ANSI/ASTM A112.18.1M. Plumbing trim for water closet bowls, tanks and urinals shall comply with ANSI/ASTM A112.19.5.

D. Similar Character and Design: Fixtures and fittings of a similar type shall be from a single manufacturer.

E. Vitreous China Fixtures: Vitreous china fixtures shall comply with ANSI A112.19.2M.

F. Enameled Cast Iron Fixtures: Enameled cast iron fixtures shall comply with ANSI A112.19.1M.

G. Porcelain Fixtures: Porcelain enameled steel fixtures shall comply with ANSI A112.19.4M.

H. Exposed Metal: Exposed metal shall be polished chromium on either brass or bronze, unless otherwise indicated. Supply valves shall have renewable seats and discs. Hot and cold water supply to fixtures shall be provided with stops. Provide P-trap with cleanout for each lavatory and sink except as indicated.

I. Concealed Carriers: Provide a cast iron or steel concealed arm, floor-mounted carrier with cast iron feet and steel uprights to support all wall mounted lavatories, sinks, urinals, and water closets. Carriers shall comply with ANSI A112.6.1.M and shall have adjustable support plates, alignment truss, and mounting fasteners. Floor mounted carriers shall withstand an applied vertical load of 250 pounds on the front of the fixture indefinitely without breaking or permanently deforming. Supports and carriers shall have adjustments capable of permitting field alignment to allow for actual site conditions.

J. Trap Primers: Traps primers shall be water supply-fed type and shall comply with ANSI/ASSE 1018.

K. Vacuum Breakers: Vacuum breakers shall be full-line size, bronze with rough chrome plating, or polished chrome plating where exposed, full-line size, and shall conform to ASSE 1001 or 1020 as applicable.

- I. Refer to Plumbing Fixture Schedule on plans.

2.2 FLOOR DRAINS

A. General: Floor drains and floor sinks shall be cast iron, shall comply with ANSI/ASME A112.21.1M, and shall be adjustable to accommodate the finished floor. Strainer size shall be as recommended by the manufacturer unless otherwise indicated. Strainers shall be polished nickel alloy or polished brass. Provide trap guard and flashing flange or clamp, unless otherwise indicated or required.

2.3 SHOWER PANS

A. Lead Pans: Shower pans shall be constructed from 6 pound per square foot density sheet lead which complies with QQ-L-201a (53) Grade A, except that 4 pound sheet lead may be used for pans installed without joints or seams, other than folded corner seams.

B. Non-Metallic Shower Pan Material: Non-plasticized chlorinated polyethylene (CPE) shower pan material shall consist of minimum 0.040 inch thick sheet material, shaped into pan dimensions as required. The material shall comply with ASTM D412 for tensile strength and elongation, ASTM D4068 for micro-organism resistance, and ASTM D568 for non-flammable and non-burning material. Water vapor transmission shall not exceed 0.090 perm. Sheet material shall be cold-solvent welded to cover large surfaces. Preformed corners and curbs may be used.

C. Copper Shower Pan: Shower pans may be constructed of one layer of sheet copper with a minimum density of 12 ounces per square foot and which complies with ASTM B 152.

2.4 CLEANOUTS AND CLEANOUT ACCESS COVERS

a. Size: Cleanouts shall be at least the same nominal pipe size as the pipe to which they are connected, to a maximum of 6 inch diameter, unless otherwise indicated.

b. Material: Cleanouts shall comply with ANSI A112.36.2M and shall be water- and gas-tight cast iron construction with adjustable housing to accommodate finished floor or grade elevation. Cleanouts in waterproofed floors shall have a flashing flange and clamp device. Cleanouts shall have a countersunk internal bronze plug and scoriated nickel-bronze removable cover; wall cleanouts shall have polished stainless steel cover specifically manufactured for the wall finish at each location. Floor cleanouts for floors with finish coverings shall have the top recessed for tile or carpet, with a cleanout marker, manufactured for the finished floor material.

c. Access Cover: Access covers for concealed wall cleanouts shall be nickel-bronze with scoriated hinged cover or round stainless steel cover with countersunk machine threaded center screw, unless otherwise indicated.

2.5 WATER HAMMER ARRESTER

A. Manufactured Water Hammer Arrester: Water hammer arresters shall be designed, manufactured, tested and certified in accordance with PDI Standard WH201. Arresters shall be Type L copper tube construction, with a piston and heat sink. The piston shall have pressure lubricated O-rings separating the compressed air charge from the flowing fluid to dissipate the

kinetic energy generated in the piping system. Each arrester shall be sized according the table and shall have a male sweat connection. Unless specifically indicated otherwise, calculated or field constructed air chambers are not acceptable.

1. Manufacturer: PPP, Inc., Sioux Chief or approved substitution.

PART 3 - EXECUTION

3.1 GENERAL

A. Vacuum Breakers: Where not provided as an integral part of a device or fixture, provide vacuum breakers at each fixture to prevent back-siphoning.

B. Eye Wash/Emergency Shower: Provide an isolation valve for each eye wash station, emergency shower, or combination, whether indicated or not. Isolation valve shall be OS&Y type only.

1. Provide a flow switch in the water supply for alarm.

C. Piping: Plumbing piping to fixtures shall be secured to the wall framing system prior to installation of the wall surface material to assure a solid installation which will not move. Fixture piping which can be moved shall be removed and re-secured to the wall structure; replacement of the wall, finishes, trim, etc. shall be included at no cost to the Owner.

D. Clearances: Install fixtures in accordance with manufacturer's data, with sufficient clearances to coordinate with accessories, specialties and equipment.

E. Mop Sinks: Unless otherwise indicated, mop sinks or basins shall be floor mounted and sealed watertight, at walls and seams.

3.2 SHOWER PANS

- A. One Piece Shower Pan:** The floor of each individual shower, or combination shower and drying room, shall be made smooth and watertight with a shower pan fabricated in place. The shower pan material shall be cut to size and shape of the area with corners folded, in one piece allowing not less than 8 inches for turn-up on walls or partitions, and shall be folded over the curb with an approximate return of 1/4 the curb height. The upstands shall be placed behind the wall or partition finish. Shower pans shall be clamped to the drain.
- B. Shower Pan Test:** After installation of the pan the drain shall be temporarily plugged below the weep holes. The floor area shall be flooded with water to a minimum depth of 4 inches at curb areas and 1 inch without curbs for a period of 24 hours. Any drop in the water level during the test shall be reason for rejection. The pan shall be repaired and retested until proven watertight.

- C. Two Piece Shower Pan: When a shower pan of required size cannot be furnished in one piece, 2 separate pieces shall be joined with a flat-lock seam and soldered or solvent-welded as applicable. Metal pans and upstands shall be coated evenly inside and outside with one brush coat of roofing asphalt at not less than one gallon per 50 square feet. The joining surfaces of metal pan and drain shall be given a brush coat of roofing asphalt after the pan is connected to the drain.
- D. Non-Metallic Shower Pan: Follow manufacturer's installation instructions, including solvent-welding seams.
- E. Electrically Insulated: Metal shower pans shall be electrically insulated from conductive substances, except the shower drain, by a minimum one layer of 15 pound asphalt felt.

3.3 TRAP GUARDS

- A. Trap Guard: Elastomeric tubing device molded to prevent sewer gasses from escaping through P-Traps. Trap Guard shall be ASSE 1072 listed.

3.4 CLEANOUTS AND CLEANOUT ACCESS COVERS

- A. Exterior Cleanouts: Extend exterior cleanouts to finished grade. Provide a concrete pad 18 inches by 18 inches, 6 inches thick around cleanout; slope top down approximately 2 inches from the cleanout to edge of pad so that edge of pad is flush with finished grade.
- B. Locations: Cleanouts shall be provided at not more than 50 feet apart in horizontal drainage lines. Cleanouts shall be provided at each change of direction of 45 degrees or more. Cleanouts shall be provided in vertical sanitary and storm water piping, with the centerline not more than 18 inches above the finished floor level, at each floor with a horizontal offset or horizontal branch connection.

3.5 WATER HAMMER ARRESTERS

- A. General: Install water hammer arresters on both hot and cold water piping in accordance with manufacturer's recommendations. Water hammer arresters shall be installed at each valve-operated plumbing fixture, or at the end of piping branches serving a battery of valve-operated fixtures. In addition, water hammer arresters shall be installed at each solenoid valve, at each remotely-operated valve, or at each quick-closing valve as defined by PDI WH-201, as close to the point of quick closure as possible.

3.6 INSULATION OF ACCESSIBLE LAVATORY EXPOSED PIPING

- A. General: Insulate hot water supply and waste lines for accessible lavatories with 1/2 inch thick elastomeric or fiberglass insulation. All joints shall be sealed and provided with a white finish.

3.7 DRAINS

- A. General: Drains shall be located at the low point of indicated slopes, or 1/2 inch below the finished surface, Install to prevent ponding around the perimeter of the drain.

3.8 FIXTURE INSTALLATION

- A.** General: Obtain mounting templates and dimensions prior to roughing-in plumbing connections. Mount fixture on carrier which is bolted to the building structure with through-bolts or pre-set inserts. Floor-mounted fixtures shall have supports, blocking or a non-shrink grout setting bed to prevent movement or flexing. Floor-mounted, wall mounted and countertop fixtures shall be sealed watertight with a flexible, non-permeable caulk or mastic. Provide stainless steel escutcheons at each water supply and waste piping penetration of a wall or cabinet; caulk each escutcheon. Adjust all fixtures level and plumb at proper mounting height.
- B.** Rough-In: During rough-in, water and waste stub-outs shall be located to prevent gaps between the fixture and the finished wall, and to allow exposed pipe to be installed straight and plumb from the stub-out to the fixture. Continuously cover wall openings and open pipe ends to prevent construction debris from entering.
- C.** Special Fixtures: For equipment to be connected later or under a separate contract, provide valved and capped water lines; provide floor drains, open site drains, or capped water connections as indicated or required.
- D.** Fixture Connections: Provide valve cocks or stops in pressure piping to fixtures in lines 1/2 inch or smaller; provide gate valves in piping 3/4 inch and larger. Provide a water seal trap with each fixture (including floor drains and floor sinks) whether indicated or not. Drains shall be sized as indicated or required but in no case less than 1-1/2 inch pipe size.

END OF SECTION 22 40 00

SECTION 23 05 01 - BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including Contractual Conditions and other Specification Sections, apply to this Section.

1.2 SUMMARY

A. Mechanical systems, equipment, devices and accessories shall be installed, finished, tested and adjusted for continuous and proper operation. Any apparatus, material or device not shown on the Drawings but mentioned in these Specifications, or vice versa, or any incidental accessories necessary to make the project complete and operational in all respects, shall be provided. Include all materials, equipment, supervision, operation, methods and labor for the fabrication, installation, start-up and tests necessary for complete and properly functioning systems.

1.3 QUALITY ASSURANCE

a. Code Compliance: Comply with all rules, laws, statutes, regulations, building codes, and the amendments of local, state and federal governments by the authorities having jurisdiction.

b. ADA: Comply with the requirements of the Americans with Disabilities Act (ADA).

c. NFPA: Comply with the National Fire Codes compiled by the National Fire Protection Association.

d. Conform in strict compliance to the current editions of Florida Building Code; Florida Mechanical Code; Florida Plumbing Code; International Fuel Gas Code; and the amendments to these codes which are enforced by the local authority having lawful jurisdiction.

1.4 DRAWINGS AND SPECIFICATIONS

A. Equipment Placement: The drawings are diagrammatic, intended to show general arrangement, capacity and location of various components, equipment and devices. Reasonable changes in locations ordered by the Engineer prior to the installation may be made at no additional cost.

B. Drawing Scale: Due to the small scale of the drawings, and to unforeseen job conditions, all required offsets, transitions and fittings may not be shown but shall be provided at no additional cost.

1.5 DEFINITIONS

a. Concealed: When standing inside a finished room, insulated or non-insulated piping or ductwork not visible after installation, such as inside a chase or above a ceiling.

b. Exposed: When standing inside a finished room, insulated piping or ductwork is visible after installation, such as inside an equipment room or an air handling unit room.

c. Protected: The surface of insulated or non-insulated piping or ductwork on the exterior of the building but protected from direct exposure to the weather by an overhang, eave, in an unconditioned parking garage or building crawl space.

d. Unprotected: The surface of insulated on non-insulated piping or ductwork on the exterior of the building and exposed to the weather.

1.6 SUBMITTALS

a. Shop Drawings: Shop drawings include piping system layouts, ductwork layouts, fabrication and installation drawings of supports and anchorage for mechanical materials and equipment, and coordination drawings. Shop drawings also include proposed equipment layouts, drawn to scale, indicating that proposed equipment will fit into allotted space, including service access, connections, etc.

1. Piping Systems: Submit shop drawings for piping systems drawn at a minimum scale of ¼ inch per foot to verify clearances and equipment locations. Show required maintenance and operational clearances. Include the following:

- a)** Architectural and structural backgrounds with room names and numbers, including but not limited to plans, sections, elevations and details.
- b)** Fabrication and erection dimensions.
- c)** Arrangements and sectional views.
- d)** Details, including complete information for making connections to equipment.
- e)** Descriptive names of equipment.
- f)** Modifications and options to standard equipment required by Contract Documents.

2. Ductwork: Submit shop drawings for duct systems at a minimum scale of 1/4 inch per foot to verify clearances and equipment locations. Show required maintenance and operational clearances. Include the following:

- a)** Architectural and structural backgrounds with room names and numbers, etc., including but not limited to plans, sections, elevations, details, etc.
- b)** Fabrication and erection dimensions.
- c)** Arrangements and sectional views.
- d)** Details, including complete information for making connections to equipment.
- e)** Materials and finishes.
- f)** Descriptive names of equipment.
- g)** Modifications and options to standard equipment required by Contract Documents.

3. Coordination Drawings: Submit coordination drawings including detailed drawings showing locations and positions of all Architectural, structural, electrical and mechanical elements. Drawings shall be minimum ¼ inch per foot for each mechanical equipment room, mechanical riser, or chase. All other areas shall be a minimum 1/8 inch per foot.

b. Product Data: Product data includes the manufacturer's printed literature.

c. Performance Data: Provide performance data, wiring and control diagrams.

d. Installation Instructions: Installation instructions include detailed information, from the manufacturer, indicating specific installation requirements, instructions, and recommendations. Generic installation instructions are not acceptable. Instructions shall be the same as those included with the product when it is shipped from the factory.

e. Written Operating Instructions: Operating instructions shall be the manufacturer's written operating instructions for the specified product. If the instructions cover more than one model or type of product they shall be clearly marked to identify the instructions that cover the product delivered to the project.

f. Maintenance Instructions: Maintenance instructions shall be the manufacturer's printed instructions and parts lists for the equipment furnished. If the instructions cover more than one model or type of equipment they shall be marked to identify the instructions for the furnished product.

1.7 MANUFACTURER'S EQUIPMENT AND SYSTEMS STARTUP AND PERFORMANCE CHECKOUT

A. At the completion of installation, a factory trained representative of the equipment manufacturer shall provide start-up and checkout services. The manufacturer's representative shall examine performance information and check the equipment in operation.

1.8 INSTRUCTION TO THE OWNER

A. General: Instructions to the Owner shall be accomplished by representatives of the manufacturers involved. Allow time for complete coverage of all operating procedures. Provide classroom instruction and field training in the design, operation and maintenance of the equipment and troubleshooting procedures. Explain the identification system, operational diagrams, emergency and alarm provisions, sequencing requirements, seasonal provisions, security, safety, efficiency and similar provisions of the systems. On the date of substantial completion, turn over the prime responsibility for operation of the mechanical equipment and systems to the Owner's operating personnel.

B. Training Period: Training period shall encompass a minimum of 4 hours of classroom and 4 hours of hands-on instructions with a maximum period of 4 hours per day.

C. Scheduling: Submit any remaining required items for checking at least one week before final inspection of the work. When submittal items are found acceptable, notify the Owner, in writing, that an "Instruction Conference" may proceed. Conference will be scheduled by the Owner. After the conference, copies of a memo certifying that the "Instruction Conference" and "Completed Demonstration" have been made will be signed by the Owner and the instructors, and one copy will be inserted in each submittal binder.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Specified Products: Manufacturer's names and product model numbers indicated on the drawings and in these specifications establish the type, style, quality, performance, and sound rating of the desired product. Listing of other manufacturers indicates that their equivalent products would be acceptable if they meet the specification requirements, the specific use and installation shown on the drawings, including space and clearance requirements, and the energy consumption and efficiency of the specified product.

B. Space Requirements: All manufactured products furnished on this project must have the required space and service areas indicated in the manufacturer's printed literature or shown on their approved shop drawings. When the manufacturer does not indicate the space required for servicing the equipment, the space shown on the drawings or as required by the Engineer must be provided.

2.2 MATERIAL AND EQUIPMENT

A. General: Material and equipment used shall be produced by manufacturers regularly engaged in the production of similar items, and with a history of satisfactory use as judged by the Engineer.

B. Specified Equipment: Equipment shall be the capacity and types indicated. Equipment and material furnished shall be the manufacturer's standard item of production unless specified or required to be modified to suit job conditions. Sizes, material, finish, dimensions and the capacities for the specified application shall be published in catalogs for national distribution. Ratings and capacities shall be certified by a recognized rating bureau. Products shall be complete with accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for the intended use and effect.

C. Compatibility: Material and equipment of one and the same kind, type or classification and used for identical or similar purposes shall be made by the same manufacturer. Where more than one choice is available, select the options which are compatible with other products already selected. Compatibility is a basic general requirement of product selection.

PART 3 - EXECUTION

3.1 WORKMANSHIP

A. General: Personnel who install materials and equipment shall be qualified by training and experience to perform their assigned tasks.

b. Performance: Material and equipment installations not in compliance with the Contract Documents, or installed with substandard workmanship in the opinion of the Engineer, shall be removed and reinstalled.

3.2 CLEANING AND PROTECTION

a. Housekeeping: Keep interiors of duct and pipe systems clean and free from dirt, rubbish and foreign matter. Close open ends of piping and ductwork at all times throughout the installation. Install 30% efficient filter media over each return air grille and open return duct opening; change media regularly during construction when dirty to keep duct interiors clean. Prevent dust, debris and foreign material from entering the piping and ductwork.

b. Equipment Protection: Protect fan motors, switches, equipment, fixtures, and other items from dirt, rubbish and foreign matter. Do not operate air handling equipment if the building is not clean or if dust can enter the coils or the fan housings.

c. Equipment Cleaning: Thoroughly clean equipment and entire piping systems internally upon completion of installation and immediately prior to Submittal Completion. Open dirt pockets and strainers, blow down each piping system and clean strainer screens of accumulated debris. Remove accumulated dirt, scale, oil and foreign substances. Thoroughly wipe clean internal surfaces of ductwork and air handling units prior substantial completion. Refer to Section 23 21 13, Pipe and Fittings, for detailed requirements for piping systems' flushing and cleaning.

d. Fixture Cleanup: Remove temporary labels, stickers, etc., from fixtures and equipment. Do not remove permanent name plates, equipment model numbers, ratings, etc.

e. Filter Replacement: Provide filters, with the same efficiency rating as required for the final installation, for the protection of the air moving equipment and ductwork continuously throughout the construction phase. Provide a new set of clean filters for the test and balance of the air side equipment.

f. Protection of Finished Installation: Where installation is required in areas previously finished by other trades, protect the area from marring, soiling or other damage.

3.3 CORRECTION OF WORK

A. General: At no additional cost to the Owner, rectify discrepancies between the actual installation and Contract Documents when in the opinion of the Testing and Balancing Agency (T&B Agency) or the Engineer the discrepancies will affect system balance and performance.

B. Drive Changes: Include the cost of all pulley, belt, and drive changes, as well as balancing dampers, valves and fittings, and access panels to achieve proper system balance recommended by the T&B Agency.

3.4 COORDINATION AND ASSISTANCE

A. General: Provide all labor, equipment, tools and material required to operate the equipment and systems necessary for the testing and balancing of the systems and for the adjustment, calibration and repair of all electric automated control devices and components. These services shall be available on each working day during the period of final testing and balancing.

B. Drawings and Specifications: Provide to the T&B Agency a complete set of project record drawings and specifications and an approved copy of all HVAC shop drawings and equipment

submittals. The T&B Agency shall be informed of all changes made to the system during construction, including applicable change orders.

C. Coordination: Coordinate the work of all trades and equipment suppliers to complete the modifications recommended by the T&B Agency and accepted by the Engineer. Cut or drill holes for the insertion of air measuring devices as directed for test purposes; repair to as-new condition, inserting plastic caps or covers to prevent air leakage. Repair or replace insulation and re-establish the integrity of the vapor retardant.

3.5 PREPARATIONS FOR PERFORMANCE VERIFICATION

A. Verification: Prior to commencement of balancing by the T&B Agency, verify the following in writing:

1. Air filters have been replaced and are clean.
2. Linkages between dampers and their actuators are secure, non-overloading and non-binding.
3. Ductwork specialties are in their normal operating positions.
4. Fans are operating at the correct rotation and specified RPM.
5. Ductwork has been pressure tested and accepted.
6. Operating safety features (such as thermal overloads, firestats, freezestats, smoke detectors and relief valves), are installed and fully functional.
7. Equipment has been lubricated and can be operated without damage.
8. Systems are operational and complete.
9. No latent residual work remains to be completed.

3.6 PROTECTION OF MATERIALS AND EQUIPMENT

A. Requirements: Do not store fiberglass insulation or any equipment within the building until it has been "dried in". If dry space is unavailable and the insulation and equipment must be installed or stored before the building is "dried in" and completely enclosed, provide polyethylene film cover for protection.

B. Replacement of Damaged Stored Material and Equipment: Any material and equipment that has been wet or otherwise damaged prior to installation shall be replaced with new material regardless of the condition of the material and equipment at the time of installation.

C. Repair of Damaged Installed Material and Equipment: After installation correct or repair dents, scratches and other visible blemishes. At the direction of Engineer replace or repair to "as new" condition equipment which has been damaged during construction.

3.7 COORDINATION OF SERVICES

a. Interruption of existing services: Provide shutoff valves at points of interconnection to minimize downtime.

END OF SECTION 23 05 01

SECTION 23 05 02 - ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Basic Requirements: Provisions of Section 23 05 01, BASIC MECHANICAL REQUIREMENTS are part of this Section.

1.2 SUMMARY

A. General: Provide electric motors and related electric material and equipment required for all mechanical work.

1.3 APPLICABLE STANDARDS

a. Requirements: The electrical equipment, components and installation shall comply with the requirements of the following regulations:

1. NEC: National Electrical Code (NFPA 70).
2. NEMA: National Electric Manufacturer's Association Standard MG-2.

PART 2 - PRODUCTS

2.1 ELECTRIC MOTOR

A. Manufacturers:

1. General Electric
2. Westinghouse
3. Baldor Electric Co.
4. Emerson
5. Lincoln

B. General:

1. Provide motors for continuous duty conditions in which they will be required to perform; i.e., general purpose, splashproof, explosion proof, standard load, high torque, or any other special type as required by the equipment motor manufacturer's recommendations. Unless otherwise indicated or required, motors shall be open drip-proof type.
2. Motors installed outdoors shall be totally enclosed fan cooled (TEFC) type.
3. Motor enclosures shall be of the type recommended by the equipment manufacturer for the specific application.
4. All motors shall be furnished for starting in accordance with the electric utility company's requirements and shall be compatible with the motor starter and driven load. Motors shall not exceed full-rated nameplate load when operated at any point along the driven equipment's characteristic performance curve. The motor service factor shall not be used to justify exceeding nameplate amperage.

5. Sound power levels for motors shall be no greater than the guidelines recommended by NEMA MG 1-12.49. A motor which generates excessive noise within an occupied area of the building shall be replaced with a quieter operating motor at no additional cost to the Owner.
6. Verify the circuit voltage and phase being furnished to the motor. All motors shall be 1750 rpm unless noted otherwise. Motors shall operate with electrical input voltage variations of plus or minus 1 percent of nameplate rating or frequency variations of plus or minus 5 percent of nameplate rating.

C. Design: Provide NEMA Design B for normal starting torque with Standard MG1-12.42 Class B insulation unless noted otherwise or required by the equipment on which the motor is being used, except that motors for variable-speed service shall have Class F insulation. Motors shall be designed for operation in 40 degree C. ambient at 1.15 service factor on sine wave power at the base voltage and frequency and shall have all copper windings. Motors shall meet or exceed the locked-rotor (starting) and breakdown (maximum) torques for the NEMA rating. Locked rotor current shall not exceed 6 times full-load current. Motor current density and heating characteristics shall be such that the motor insulation will not fail if subjected to locked-rotor current for 20 seconds.

D. Efficiency: Motors 1 horsepower and larger shall be high efficiency design. Nominal efficiency of each motor shall meet or exceed the value listed below when tested in accordance with NEMA MG 1-12.54.1 and shall be labeled on the motor nameplate in accordance with NEMA MG 1.12.54.2. High-efficiency motors shall be different from the manufacturer's standard product through the use of premium materials, design and improved manufacturing processes to reduce motor losses.

TABLE - MOTOR EFFICIENCY

HP	2-Pole 3600 RPM		4-Pole 1800 RPM	
	Nominal	Minimum	Nominal	Minimum
1.0	82.5	81.5	82.5	81.5
1.5	84.0	82.5	84.0	82.5
2.0	84.0	82.5	84.0	82.5
3.0	86.5	85.5	87.5	86.5
5.0	87.5	86.5	87.5	86.5
7.5	88.5	87.5	89.5	88.5
10	89.5	88.5	89.5	88.5

e. Single Phase: Single phase motors for hard starting applications including air compressors and outdoor installations shall be capacitor start/induction run or capacitor start/capacitor run type designed for the application. Motors for fans and pumps located indoor may be split phase with

permanently lubricated sealed ball bearings and shall be selected for quiet operation. Motors 1/8 horsepower and below may be shaded pole type with permanently sealed bearings.

2.2 MOTOR STARTERS

A. Compliance: Motor starters included as an integral part of a factory pre-wired control panel shall be provided by the manufacturer of the equipment it serves and shall comply with the requirements of Division 26.

B. Overload Protection: Unless otherwise indicated, all 3 phase motor starters shall be provided with thermal overload relays on each phase sized in accordance with the actual nameplate full load ampere rating. Single phase motors shall be furnished with built-in thermal protection.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install material and equipment in accordance with details shown on the drawings, submittals drawings and manufacturer's instructions.

3.2 SCHEDULED HORSEPOWER

A. Nominal Size: The horsepower scheduled or specified are those nominal sizes estimated to be required by the equipment when operating at specified duties and efficiencies. In the case of pumps and fans, these motors shall be non-overloading at any point of the performance curve.

B. Minimum Size: Motor horsepowers shall not be reduced from the scheduled size regardless of the requirements of the selected or submitted equipment.

C. Increased Size: If the actual motor horsepower for the equipment furnished is larger than the scheduled size indicated, the proper size feeder, breaker, starter, etc. shall be provided at no additional cost to the Owner.

3.3 WIRING

A. Power: All power wiring including safety disconnect switches, motor starters, over-current protection, connection to equipment, etc. shall be installed according to the requirements of Division 26, ELECTRICAL.

B. Interlock: Unless otherwise noted, all interlock wiring, such as remote line voltage thermostats, fan speed controllers, etc. shall be installed by the supplier of that equipment. Interlock wiring shall be installed according to the requirements of Division 26, ELECTRICAL.

C. Control: All control wiring exposed in mechanical equipment rooms, fan rooms, return air plenums, etc. shall be in conduit. Low voltage control wiring may be installed without conduit in return air plenums provided the cable is plenum rated and the installation is acceptable to the authority having jurisdiction.

3.4 WEATHER PROTECTION

A. Wiring: All electrical wiring exposed to the weather or in damp locations shall be enclosed in weatherproof fittings as required in Division 26, ELECTRICAL.

B. Enclosures: Enclosures for electrical equipment shall be NEMA 3R unless indicated otherwise.

END OF SECTION 23 05 02

SECTION 23 05 03 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of Section 23 05 01, BASIC MECHANICAL REQUIREMENTS, are part of this Section.

1.2 SUMMARY

A. Materials listed herein are general mechanical materials to be used for Division 23 sections of the specifications unless noted otherwise.

1.3 SUBMITTALS

a. Manufacturers Literature:

1. Product data for pitch pockets or pipe seals through roofing.
2. Access doors and panel data for each type of unit indicated.
3. Piping system identification markers and tags including a representative sample of each type.
4. Each type of pipe hanger and supporting device.
5. Curbs for roof mounted air intake and relief vents.

b. Installation Instructions:

1. Roof curbs for roof mounted air intake and relief vents including copies shipped with the units.

c. Valve tag list framed under glass and mounted in the mechanical equipment room.

1.4 APPLICABLE STANDARDS

a. ANSI: Color coding for piping systems shall comply with The American National Standards Institute, ANSI A13.1, latest edition, "Scheme for the Identification of Piping Systems".

b. NFPA: NFPA 704, Standard System for the Identification of the Fire Hazards of Materials.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials and equipment shall be products which will meet with the acceptance to the authority having jurisdiction. Where acceptance is contingent upon having the products examined, tested and certified by Underwriters Laboratories or other recognized testing laboratory, the product shall be so examined, tested and certified.

2.2 HOUSEKEEPING PADS AND EQUIPMENT SUPPORTS

A. General: Pads and supports shall extend a minimum of 4 inches and a maximum of 8 inches beyond the base or supporting member in all directions. It is the intent not to have the pad extend under the entire piece of equipment unless that equipment is located on the exterior of the building on the ground, or the weight of the pad is required for vibration control. Pads shall be 1/2 inch chamfered on all exposed edges and shall be placed and finished smooth and level to insure proper and continuous support for the bearing surfaces of the equipment, with no deviation in excess of 1/8 inch when tested with a 10 foot straight edge.

B. Size: Coordinate length and width of pads and penetrations necessary for piping or conduit with the actual equipment approved for use on the project.

C. Concrete and Steel Requirements: All concrete and steel for housekeeping pads shall comply with the requirements of Division 3, CONCRETE.

D. Housekeeping Pads:

1. Location: Provide concrete housekeeping pads for all floor mounted equipment where indicated and where located in rooms where water piping exists. Unless otherwise indicated housekeeping pads shall be reinforced with a minimum of two layers of 6 by 6 inch, 10/10 welded wire mesh with an 1-1/2 inch cover from the bottom and any exposed surface. Pads less than 18 inches wide shall be reinforced with a minimum of two #4 bars at 6 inches on centers both ways set 1-1/2 inches above the bottom of the pad.
2. Bonding: Housekeeping pads shall be bonded to the floor slab. If the equipment located on the pad must be anchored for support, the anchor bolts shall be anchored to the floor slab prior to the installation of the housekeeping pad.

2.3 ACCESS DOORS AND PANELS

A. Locations: Provide access doors and panels (access units) for access to concealed items which require service or maintenance or other reason for accessibility.

B. Manufacturer:

1. Milcor Division of Inland-Ryerson
2. Bilco
3. Nystrom
4. Ventfabrics

TABLE - ACCESS DOORS AND PANELS

Location	Door/Panel Type
Drywall	Style DW
Masonry or Tile	Style M-Stainless
Acoustical Tile	Style AT
Plaster	Style K
Fire-rated Walls	Style Fire Rated (or as indicated below)

C. Fire Rated Units:

1. Frame and panel assembly shall bear a U.L. label reading, "frame and door assembly, rating 1-1/2 hour (B), temperature rise 30 minutes 250 degrees F. maximum".
2. Shall have an automatic closing device and mechanism to release the latch bolt from the inside.
3. Manufacturer:
 - a) Boico
 - b) Inryco/Milcor
 - c) Nystrom.

D. Non-Fire Rated Units:

1. Steel panels and frames
2. Locks and latches shall be appropriate for the location and shall be cam-lock type latches, flush screw driver operated locks or cylindrical locks.
3. Provide two keys for all doors. All doors shall be keyed the same.

E. Other Requirements:

1. Doors and panels installed in glazed or ceramic tiled surfaces, in toilet rooms or in kitchens shall be stainless steel.
2. Unless otherwise indicated, finish shall be rust inhibitive prime coat.

F. Sizes:

1. Minimum size: 16 inch x 16 inch.
2. Sizes of each unit shall be individually selected to allow the recommended and required service, maintenance and accessibility functions to be accomplished. These functions shall include, for example, valve removal, damper linkage resetting, control adjustment, lubrication, repair, replacement and similar tasks necessary and recommended for the concealed item.
3. No size smaller than 24 inch x 24 inch shall be allowed when a person must pass through the access opening. Access panels for heating equipment shall be minimum 22 inch x 36 inch as required by code.

g. Finish: Coordinate with Architectural Coatings Section.

2.4 IDENTIFICATION OF PIPING AND EQUIPMENT

- A. General: Comply with ANSI A13.1, latest edition, "Scheme for Identification of Piping Systems" and OSHA requirements, or as otherwise indicated.
- b. Markers: Legends or arrows painted with stencils are not acceptable. Markers must have approved color coded background, proper color of legend in relation to background color and flow arrow indicator. Markers higher than 12 feet above the floor shall have minimum 2 inch letters. Markers shall comply with the following table:

TABLE - IDENTIFICATION MARKER SIZES

O.D. of Pipe or Covering	Length of Color Field	Size of Letters
3/4 to 1-1/4 inch	8 inches	1/2 inch
1-1/2 to 2 inches	8 inches	3/4 inch
2-1/2 to 6 inches	12 inches	1-1/4 inch
above 6 inches	12 inches	2 inches

- c. Bands: Color coded in minimum widths of 2-1/4 inch for pipe through 12 inch O.D. and 4 inch for pipe 14 inch O.D. and greater.
- d. Valve Tags: Each tag shall designate appropriate service and valve number. Secure attach with meter seals, 4-ply 0.018 copper smooth wire, brass "S" hooks, or brass jack chain to allow easy reading. All valve tags used on a project shall be the same type and manufacturer.
 - 1. Provide either of the following types:
 - a) Brass Type: Minimum 19 gauge polished brass; 1-1/2 inch min. diameter.
 - b) Aluminum Color Coded Type: Anodized aluminum; 2 inch min. diameter.
 - c) Aluminum Alloy Type: 16 Gauge sheet aluminum, depressed type letters filled with black enamel. Face and periphery of satin finish shall be free from burns and scratches.
 - d) Fiber Glass Type: 1/16 inch thick glass fiber reinforced resin. 2 inch x 2 inch size of 2-1/2 inch x 9 inch size as necessary to identify item.
- e. Equipment Labels: Provide either of the following types:
 - 1. Plastic Type: Outdoor grade acrylic plastic to withstand weather, abrasion, grease, acid, chemical and other corrosive conditions; 1/16 inch min. thickness. Sized 3/4 inch x 2-1/2 inch, 1 inch x 2-1/2 inch, 1 inch x 3 inch or 1-1/2 inch x 4 inch as necessary to identify item.
 - 2. Aluminum Type: Engraved, flexible, 0.020 inch thick aluminum. Sized to 3/4 inch x 2-1/2 inch, 1 inch x 3 inch, 1-1/2 inch x 4 inch or 3 inch x 6 inch as necessary to identify item.

2.5 PIPE HANGERS AND SUPPORTING DEVICES

A. General: Pipe hangers and supporting devices shall comply with the requirements of this section unless specifically indicated otherwise in other sections of this division.

B. Material: Pipe supporting devices apply to all piping unless modified in subsequent sections (i.e., vibration isolation) or detailed on the drawings.

1. Pipe hangers for copper pipe shall be copper or copper-plated steel, clevis type. Hangers for all other types of piping shall be galvanized steel clevis type or split ring. Pipe hangers shall be capable of vertical adjustment after erection of the piping. Hanger rods shall be galvanized.
2. Vertical piping riser clamp supports shall be constructed of steel with rounded ears and two or four holes for clamping bolts. Riser clamps shall be galvanized steel, except that riser clamps for copper and brass piping riser clamps shall have electro-plated copper or PVC coating finish.
3. Manufacturer:
 - a) Grinnell
 - b) PHD Manufacturing Inc.
 - c) Pipe Shields Incorporated
 - d) Cooper, B-Line

C. Beam Clamp: Beam clamps may be used when supporting piping from steel structures.

D. Inserts: Place concrete inserts in forms prior to the time that concrete is placed.

E. Tamp-ins: Lead tamp-ins may be used when installed in a concrete or masonry wall or other vertical surface to support a vertical hanger. Lead tamp-ins will not be permitted to support hangers from the underside of a concrete slab. (Use drilled-in anchors)

F. Drilled-in Anchors: Steel anchor set in existing or new concrete by drilling and the use of an expansion device is permitted. The anchor shall be provided with a NPT threaded rod connection.

G. Trapeze: For parallel runs of above ground suspended piping, trapeze-type hanger may be used. Provide permanent, non-conductive wrapping between copper pipe and steel trapeze hangers.

H. Prohibited Type: Powder set type fasteners or inserts shall not be used

2.6 FLOOR, WALL OR CEILING PLATES OR ESCUTCHEONS

- A. General: Shall be chrome-plated brass. Escutcheons for extended sleeves shall be of the type designed for that purpose. Solid escutcheons shall be used up to 2 inches, split ring escutcheons will be allowed for sizes 2-1/2 inches and above.
- B. Location: Provide escutcheons or fabricated plates or collars at each location where pipe or duct passes through a finished surface. Escutcheons for flush sleeves shall be chromium plated brass; for sleeves extending above floor shall be equivalent to Benton & Caldwell chrome plated brass. Collars or plates for ducts and large diameter insulated pipe shall be fabricated of 18 gage galvanized sheet steel, secured to structure and neatly fitted around duct or pipe.

2.7 SLEEVE

- A. Pipe Sleeves: Except where indicated otherwise, pipe sleeves shall be as follows:
 - 1. Sleeves installed in walls subject to hydrostatic (water) pressures shall be modular mechanical type consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve, connected with bolts and pressure plates which cause the rubber sealing elements to expand when tightened to provide a watertight seal.
 - 2. When there is piping existing, and fire rated walls are to be erected, Proset fire rated split wall system pipe sleeves, or an NFPA/UL listed pipe sleeve shall be used.
- B. Walls and Partitions:
 - 1. Sleeves (Above Grade): Sleeves shall be mild steel pipe Schedule 40 sleeves built into assembly, sized to pass pipe and covering, leaving a clear space of 1/4 inch minimum between covering and sleeve.
 - 2. Sleeves Installed in Exterior Walls (Below Grade): Schedule 40 steel hot dipped galvanized after fabrication or cast iron. Fabricate the sleeve with 1/4 inch x 3 inch center flange (water stop) around the outside.
- C. Floors (Above Grade): Sleeves shall be Schedule 10 galvanized steel. When copper or steel piping penetrates concrete slabs, Proset System for fire-rated and water pipe installations may be used.
- D. Duct Sleeves: Sleeves or openings sized for mechanical ducts and covering shall be minimum 24 gage galvanized sheet steel framed construction in roof, wall, or partitions.

2.8 V-BELT DRIVE

- A. General: Each motor driven piece of equipment not direct connected shall be provided with a V-belt drive. Belts shall be of correct cross section to fit properly in sheave grooves and shall be carefully matched for each drive. Sheaves shall be cast iron or steel, bored to fit properly on shafts and secured with keys of proper size. Drive rating shall be as recommended by the manufacturer for service but shall be at least 1.5 times the nameplate rating of motor.

B. Fan Belt Drives: Fixed pitch sheaves shall be provided unless otherwise specified. Sheave-to-sheave centerline distances shall not exceed 3 times the sum of the sheave diameters, and shall not be less than the diameter of the larger sheave.

C. Belt and Coupling Guards: Each belt drive shall be equipped with an OSHA approved guard. Guards shall be constructed of #12 U.S. standard gage 3/4 inch diamond mesh wire screen, or equivalent, welded to one inch steel angle frames, and shall enclose all belts and sheaves. Guard shall be galvanized or painted to match the piece of equipment. Tops and bottoms of guards shall be of substantial sheet metal or not less than #18 U.S. standard gauge. Braces or supports must not "bridge" sound and vibration isolators. Guards shall allow adequate provision for movement of motor required to adjust belt tension. Provide means for oiling, use of tachometers, and other maintenance and testing operations with guard in place.

D. Direct Driven Equipment: Direct-drive motor driven equipment shall have coupling guards in accordance with OSHA Regulations.

2.9 BEARINGS

A. General: Under normal loading conditions per NEMA MG1-14.45, bearings shall be 100,000-hour rated unless otherwise specified. Bearings shall be AFBMA Standard sizes.

B. Bearings shall be greasable-type unless otherwise specified as sealed-type non-greasable.

C. Housing: Bearing housings shall have long, tight running fits or rotating shields to protect against foreign mater entering the bearings and leakage of grease out of the bearing cavity. Housings for greasable bearings shall have a capped grease inlet fitting, grease relief plug on the opposite side of the inlet, and a grease reservoir in the cast inner cap.

D. Extended Lines: Provide extended lubrication lines and fittings to an accessible location for all bearings concealed by equipment housing, belt guards, etc.

E. Factory Lubrication: Provide factory greased bearings. Grease shall be premium moisture resistant containing rust inhibitors and suitable for operation in temperatures from 50 to 250 degrees F.

2.10 FAN, RELIEF AND INTAKE CURB

A. Construction: Prefabricated fan, relief and intake curbs, unless otherwise indicated, shall be constructed of 18 gauge galvanized steel with continuous welded seams (prior to galvanizing), 3 inch cant, factory installed wood nailer and insulated with 1-1/2 inch thickness 3 pound density rigid fiberglass insulation. Curb height shall be a minimum 8 inches above the finished roof surface unless otherwise indicated or required.

B. Insulated Roofs: Roof curbs on insulated roofs shall have a raised cant the same height as the insulation thickness.

C. Manufacturer:

1. Thycurb, Thybar Corporation
2. Louvers & Dampers, Inc.
3. Greenheck

PART 3 - EXECUTION

3.1 GENERAL

A. Concrete Bases and Structural Steel: Concrete bases and structural steel to support equipment and piping installed under each specification section of this division and not specifically shown on the plans shall be furnished.

3.2 HOUSEKEEPING PADS AND EQUIPMENT SUPPORT

A. Housekeeping Pads: Provide reinforced concrete housekeeping pads where indicated and for all floor mounted equipment located in rooms where water piping exist. Pads shall be 4 inches high unless otherwise indicated. Ground mounted equipment shall have an 8 inch high reinforced concrete housekeeping pad unless otherwise indicated. The pad shall extend a minimum of 6 inches above finish grade.

B. Equipment Bases: Equipment bases shall be 4 inches high unless otherwise indicated or required. Bases for air handling equipment shall be high enough to provide the required trap seal and insulation for the condensate drain.

3.3 EQUIPMENT ACCESS

A. Access Doors and Panels:

1. Locations: Provide access units at the following locations:

- a) Where additionally specified in other sections of this Division 23 and where specifically indicated on the drawings.
- b) Where not specifically indicated on the drawings but where the work to be provided will require accessibility for purposes as described or as recommended by the manufacturer of the concealed item.
- c) At all locations where concealed equipment, fixtures, devices and similar items require accessibility for service, inspection, maintenance, repair, replacement and where such concealed item would not otherwise be accessible for such functions without the provision of an appropriately sized access unit.

2. Coordination of Determination of Locations: Coordinate the work as related to the determination of where access units are to be located.

B. Rejection of Work: Access units which are not in compliance with this Section shall be replaced.

3.4 PAINTING

A. General: Paint all exposed piping, insulation, equipment, structural bases, racks, in equipment rooms and on roof, furnished under Division 23 of these specifications. All exposed metal surfaces shall be given one prime coat and two finish coats of rust inhibiting epoxy paint. All insulated surfaces shall be given one coat of glue sizing (omit this step if factory applied finish is suitable to receive prime coat), one prime coat and one finish coat. Factory painted or finished items do not require field painting but shall require "touch-up" with matching paint or finish where scratched. Follow manufacturers' recommendations on ambient conditions for painting, coat thickness, and drying time between coats.

B. Ancillary Items: Pipe hangers, saddles, supports, riser clamps and accessories shall be painted to match their piping.

C. Inaccessible Items: Equipment not completely accessible for painting when set in place shall be painted to match the existing color scheme for renovation projects and per the following schedule for new projects.

D. Concealed Items: Concealed piping need not be painted.

E. Metal Surfaces: Prepare surfaces in accordance with Architectural Coatings Section.

F. Colors: Colors for piping systems and equipment which are required to be painted shall be as indicated in the following table:

TABLE - PIPING PAINTING SCHEDULE

Class	Paint Color
D - Dangerous Material	Yellow (or Orange)
S - Safe Material	Green (or the achromatic colors White, Black, Gray or Aluminum)
P - Protective Material	Bright Blue
V - Valuable Material	Deep Purple

3.5 IDENTIFICATION OF PIPING AND EQUIPMENT

A. General: Apply after completion of insulation, painting and cleaning work so that final identification is not disfigured.

B. Markers and Bands:

1. Coordinate with composition and operating temperatures of surface for permanent adhesion of markers and labels to surface.
2. Locate marking and banding to facilitate ease of visual tracking. (For example, mark and band parallel runs of pipe which are side-by-side at the same general place.) Labels on vertical piping shall be 7 foot above the floor.
3. Pipes less than 3/4 inch diameter may be identified with tags similar to those specified for valves.

4. Adhere or affix all identification items permanently except where removal may be necessary for maintenance or service. Where labels or arrows are used, overlap the label ends 2 inches with matching color bands completely encircling the pipe.
5. Apply labels on the bottom lower quarters of overhead pipe. Pipe within 24 inches of a wall does not require a label on the quarter facing the wall.
6. Pipe Concealed in Inaccessible Locations (e.g., Chases, non-accessible ceilings): No identification required.
7. Pipe Concealed in Accessible Locations (e.g., Ceiling Plenums): Markers every 30 feet of pipe length. Bands every 15 feet of pipe length.
8. Pipe Exposed in Equipment Rooms: Markers and bands every 15 feet of pipe length for pipe through 12 inch O.D. and every 30 feet for pipe 14 inch O.D. and greater.
9. Exterior Pipe, Exposed: No identification required unless otherwise indicated.
10. Exterior Pipe, Underground: Place a color-coded 6 inch wide, 0.004 inch thick polyethylene printed identification tape directly above all underground piping systems. The tapes shall be located approximately 12 inches below finish grade. Each tape shall be continuously printed with the words "CAUTION" in large bold lettering, and with the type of service piping also indicated.

C. Valve Tags: Valve tags shall be installed on the following items:

1. All control valves (except those valves associated with direct control of flow to air handling apparatus whereby the valve may be identified by reference to the item of equipment it serves).
2. All fire protection system valves located in mains and branches (except those valves in fire hose cabinets).
3. Valves installed under Division 23 of the specifications except check valves, drain valves, gauge valves, and manual air vent valves.
4. Small piping (other than domestic water) where markers are impractical.
5. Small but critical equipment items on which it is impractical to install labels.

D. Valve Tag List: Prior to requesting Substantial Completion, provide a complete list of all valves having tags. Frame under glass and mount in the mechanical equipment room at a location acceptable to the Designer. Indicate the following:

1. Valve size
2. Valve location
3. Valve type
4. Service application
5. Valve manufacturer and model number
6. Pressure class and allowable working pressure
7. Safety warnings
8. Sequencing information
9. Seasonal operating position (normally open/normally closed)

E. Labels: Provide labels of proper size on mechanical system equipment including but not limited to, pumps, chillers, tanks, major piping components such as air separators, air handling equipment, fans, control panels, terminal units, flow stations, reheat coils and similar items. Provide labels on access panels indicating the item accessible through the panel. Equipment labels shall be mechanically fastened with machine screws or rivets; adhesive securing is not acceptable.

F. Identification: Coordinate colors and finishes with pipe identification markers.

3.6 HANGERS AND INSERTS

A. General: Refer also to other sections which may describe additional requirements for hanging and supporting.

B. Location: Locate hangers to support piping and equipment. Arrange hangers to permit expansion and contraction. Do not hang piping from fire or smoke walls. Provide pipe hangers at each valve, strainer, and other piping accessory, and at each change of direction.

C. Size: The size of hanger for non-insulated pipes shall be suitable for pipe size to be supported. For insulated piping, the size of the hanger shall be suitable for the pipe size, plus the insulation and an insulation shield. Refer to Section 23 07 00, THERMAL INSULATION, for insulation shield requirements.

D. Protection: Isolation of copper pipe from steel trapeze hangers shall consist of wrapping pipe and 1 inch each side of contact surface with not less than two layers of adhesive type plastic dielectric insulating tape.

E. Spacing: Locate pipe supports as indicated in the following table unless noted otherwise in other sections of the specifications or on the drawings:

TABLE - HORIZONTAL PIPE HANGER SCHEDULE

Material	Pipe Size	Hanger Spacing
Steel Pipe	Under 1 inch	6 foot centers
	1 to 2 inches	8 foot centers
	2-1/2 to 4 inches	10 foot centers
	5 inches and larger	12 foot centers
Copper Tubing	up to 1-1/4	6 foot centers
	1-1/2 and above	10 foot centers
Cast Iron Pipe	All	5 foot centers

1. Vertical Pipe: Vertical piping shall be supported at the base of each vertical riser, and at intervals not exceeding those indicated in the following table:

TABLE - VERTICAL PIPE SUPPORT SCHEDULE

Material	Pipe Size	Support Spacing
Steel Pipe	All	Every other story (30 foot centers max)
Copper Tubing	up to 1-1/4	4 foot centers
	1-1/2 and above	Every story
Cast Iron Pipe	All	Every story (15 foot centers maximum)

F. Hanger Rods: The size of the hanger rods shall be according to the following table. The rod sizes are based on the maximum hanger spacing indicated in the table above.

Pipe Size Inches	Minimum Hanger Rod Size, Inches	
	Cast Iron	Copper or Steel
Up to 6	3/8	3/8
8	1/2	1/2
10	1/2	5/8

* Indicates mechanical joint, ductile iron pipe.

G. Pipe Guides: Provide pipe alignment guides to guide expanding pipe to move freely from anchor points in expansion joints, loops or bends.

3.7 ANCHORS

A. General: Install a suitable anchor on piping to prevent movement from expansion and contraction by welding or clamping securely to pipe at fitting or coupling. Approval of the Designer/OAR of method of anchorage must be obtained before installation of work. Properly anchor piping to remove strains on equipment which would be caused by expansion and contraction. Insulate anchors on piping to prevent moisture condensation problems.

B. Below Grade: Where mechanical joint piping enters the building below grade, the last section of pipe shall have anchor bolts tied to the building structure.

3.8 SLEEVES

A. General: Lay out work and set sleeves in new or existing construction for a minimum of cutting, drilling and patching. Sleeves not used during construction shall be sealed using grout. Unused penetrations or sleeves through fire and smoke rated partitions shall be sealed to prevent passage of fire and smoke using an Underwriters Laboratories approved method rated at least equal to the partition being penetrated; method utilized must show proof of UL approval.

B. Placement: Extend sleeves through walls, partitions and ceilings to finished surface. Extend sleeves 1/4 inch above finished concrete floors and 1 inch above slab in chases. Sleeves, installed above finished ceilings, for fire/smoke rated wall assemblies shall extend 1 inch beyond each face of wall. Sleeves shall be set before floor is poured, sized to pass pipe and covering, leaving a clear space of 1/4 inch between covering and sleeve.

C. Size: Size sleeves to permit clearance for pipe movement and proper grading of pipes. Sleeves for insulated pipe shall be sized to clear insulation.

D. Sealing of Sleeves:

1. Sleeves Below Grade: Make wall penetration water tight with mechanical link-seal.
2. Sleeves Above Grade Through Non-rated Surface: Openings around pipes, duct, etc., passing through sleeves shall be draft free and vermin-proof and sealed with suitable caulking.
3. Sealing of Sleeves Through Fire or Smoke Rated Partition: All penetrations through fire rated partition shall comply with the requirements of paragraph entitled "FIRE/SMOKE RATED FLOOR, PARTITION OR WALL PENETRATION SEALANT" in this section.

E. Fire/Smoke Penetrations: Caulk space between insulation or pipe and sleeve and seal with fire rated material (or flexible fire retardant sealant if pipe is subject to expansion or contraction) to serve as a fire and smoke stop.

F. Water Tight: Sleeves in walls and/or slabs subject to hydrostatic pressures shall be water tight.

3.9 ESCUTCHEONS

A. General: Provide escutcheons (for 1/4 or 1 inch projecting sleeves as required) at each point where pipe passes through a finished surface.

3.8 V-BELT DRIVE

A. Sheaves: To provide the properly sized sheave, V-belt drive fans shall be initially provided with variable pitch sheaves. Upon completion of system balancing by the T&B Agency, the adjustable pitch sheaves shall be replaced with fixed sheaves and belts of the size and type specified by the T&B Agency. Tag the adjustable sheaves and receive written receipt from the Owner accepting these sheaves.

3.9 EXCAVATION AND BACKFILL

A. General: Comply with the requirements of Division 2. Perform in accordance with applicable State and Local codes and with other applicable sections or divisions. See identification tape requirement indicated above.

B. Excavation: Excavate to a minimum necessary depth. Provide an even undisturbed surface to ensure a solid, continuous bearing surface. If cut is too deep, backfill with clean earth and hand tamp. Form depressions at joints to receive collars and couplings.

C. Backfill: Comply with requirements of Division 2.

3.10 SEALANT

A. General: Fire/smoke sealant shall be installed in strict compliance with the manufacturer's installation instructions.

3.11 EQUIPMENT CURB

A. Structural Support: Each equipment curb or mounting rail shall be fully supported by the roof structure. Changes in roof mounted equipment may require a change in the structural support. Any discrepancies shall be reported to the Designer prior to the purchase and installation of the equipment curb or mounting rails.

B. Installation: Follow the manufacturer's recommendations for installation. The top of each curb shall be level, with the pitch built into the curb where roof slopes 1/4 of an inch per foot or more. The installation and flashing of the roof curbs shall comply with the requirements of Division 7, THERMAL AND MOISTURE PROTECTION. Each equipment curb or mounting support shall be provided with a watertight counter flashing.

END OF SECTION 23 05 03

SECTION 23 07 00 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Basic Requirements: Provisions of Section 23 05 01, BASIC MECHANICAL REQUIREMENTS are a part of this Section.

1.2 SUMMARY

A. General: Provide thermal insulation as indicated. Materials such as fasteners and retainers not specifically described but required for a complete and proper installation shall be provided.

1.3 SUBMITTALS

A. General: Include the following data:

1. Manufacturers Literature:

- a)** Provide data on all types of insulation, jacketing, sealer and adhesive required by this section of these specifications, with indication of each material and its intended application.

2. Performance Data:

- a)** Provide thermal performance, density and vapor permeance for each type of insulation, finish, cover, facing or jacket specified in this section.
- b)** Unless otherwise stated, insulation types and thicknesses specified are based on insulating materials having a "K" value (BTU per hour per square foot per degree temperature difference) per inch of thickness as indicated.
- c)** Vapor permeance is based on vapor retardant materials having water vapor transmission rates in perms (grains of vapor per hour per square foot per inch of mercury vapor pressure differential).
- d)** Alternate materials shall be approved on the basis of thicknesses providing equivalent heat transfer or vapor transmission rates.

- 3.** Installation Instructions: Provide copy of manufacturer's printed installation instructions for all insulation materials including copies shipped with the material.

1.4 APPLICABLE STANDARDS

A. General: All equipment, material, accessories, methods of construction and reinforcement, finish quality, workmanship and installation shall comply with the paragraph entitled "Code Compliance" in Section 23 05 01.

B. NFPA: All materials and adhesives used shall conform to the requirements of NFPA 90A as to flame spread and smoke developed ratings throughout their operating temperature range. All insulation, jackets, covers, facings and adhesives used to adhere the jacket or facing to the insulation, including fittings and butt strips, shall have a non-combustible fire and smoke hazard rating and label as tested by ASTM E-84, NFPA 255 and UL-723 not exceeding flame spread value of 25 and smoke developed/fuel contributed value of 50. Accessories such as mastics, cements, tapes and cloth for fittings shall have the same ratings.

C. ASHRAE: Insulation thermal conductance values and insulation thicknesses shall comply with the requirements of the American Society of Heating, Refrigeration, and Air Conditioning Engineers, Inc. (ASHRAE) Standard 90.1.

d. Industry standards: Where compliance with an industry, society or association standard is specified or indicated, certification of such compliance shall be included in the submittal.

e. Packaging Information: All products or their shipping cartons shall bear the Underwriter's Label indicating that flame and smoke ratings do not exceed the above criteria. Every package or container of insulation, jacketing, facing, cement, adhesive, or coating delivered to the project site must have a manufacturer's stamp or label attached, giving the brand and a description of the material. All vapor retardants shall be labeled, indicating the thickness, product nomenclature and manufacturer.

1.5 DEFINITIONS

A. General: The following definitions apply to this section of these specifications:

1. **Concealed:** The exterior surface of the insulation is concealed from view when standing inside a finished room, such as piping or duct insulation inside a chase or above a ceiling.
2. **Exposed:** The exterior surface of the insulation is seen from inside a finished room, such as piping or duct insulation inside an equipment or air handling unit room.
3. **Protected:** With reference to insulation material on the exterior of the building but protected from direct exposure to rain by an overhang or eave. Piping or duct insulation located in an unconditioned parking garage or building crawl space.
4. **Unprotected:** With reference to insulation material on the exterior of the building and exposed to rain.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials: The insulation materials and installation procedures shall be as indicated in this section and must be approved by the insulation product manufacturer for each particular application. The actual products to be used must comply with the insulation material for the specific application as indicated in other sections of these specifications.

B. Applicability: Products and manufacturers listed may not all be applicable. Use only those products and manufacturers which are indicated as being applicable to a specific insulation condition. Insulating materials shall be resilient and moisture-resistant so that the insulating properties will not be affected by rough handling, water damage and similar construction hazards.

All adhesives, sealers and vapor retardant coatings shall be compatible with the materials to which they are applied, and shall not corrode, soften or attack such materials when wet or dry.

C. Acceptable Manufacturers: Manufacturers which are listed are those manufacturers who may make one or more of the insulation products required. Listing of a manufacturer does not mean the manufacturer is approved for all applicable insulation conditions. Manufacturers must comply with the requirements of each insulation condition to be acceptable for the application.

2.2 ELASTOMERIC CELLULAR FOAM

a. General: Flexible foam-type expanded closed-cell preformed (tube), roll or sheet as applicable. Nitrile, rubber based, closed cell structure. Maximum K value of 0.27 at 75 degrees F., and maximum water vapor transmission of 0.02 perm. Allowable temperature applications from -40 degrees F. to 220 degrees F. when installed in accordance with manufacturer's recommendations. Do not install in return air plenums.

1. Pipe Insulation: Preformed elastomeric.

2. Sheet Elastomeric Insulation: Field formed, fitted and finished as required for the application.

a) Manufacturer:

- 1) Armstrong AP Armaflex
- 2) Rubatex
- 3) Approved Substitution

b. Adhesive: For joints and seams in foam insulation.

1. Manufacturer and Product:

- a) Rubatex R-373 Insulation Adhesive
- b) Armstrong 520 Adhesive
- c) Approved Substitution

c. Finishing Coating: For weather protection of foam insulations.

1. Manufacturer and Product:

- a) Rubatex 374 coating
- b) Armstrong Armaflex Finish
- c) Approved Substitution

2.3 FIBERGLASS INSULATION

- A. General:** Inorganic fibrous glass.
- B. Board:** Faced rigid or semi-rigid form. Stiffness of 800 EI unless otherwise indicated.
1. Duct insulation external: Fiberglass semi-rigid board. Composed of resin bonded glass fibers faced with a foil scrim-kraft (FSK) reinforced laminate of aluminum foil and kraft bonded to provide a metallic surface finish vapor retardant; alternate vapor retardant facing (if specifically indicated) is an all service jacket (ASJ) of high intensity white bleached, chemically treated kraft paper reinforced with fiberglass yarn mesh and laminated to aluminum foil with fire-retardant adhesive to impart a clean, white appearance. Conductivity (K) of not less than 0.23 at 75 degrees F. Provide in thickness of 1-1/2 inches unless otherwise indicated. Provide with minimum density of 3-pcf unless 6-pcf is specifically indicated.
 - a) Manufacturer:
 - 1) CertainTeed
 - 2) Schuller
 - 3) Owens-Corning
 - 4) Knauf
 2. Equipment insulation: Rigid, minimum 6-pcf density fiberglass with factory-applied laminated foil vapor retardant Kraft- reinforced with a glass fiber scrim. The board shall be minimum 1-1/2 inch thick with a K-value of 0.22 at 75 degrees F. mean temperature, maximum vapor transmission of 0.02 perm and be able to operate from -20 to 450 degrees F. If insulation having a higher K-value is used, the thickness shall be increased proportionally to achieve the specified K rating. Boards shall have a minimum dimension of 10 inch and a maximum dimension of 48 inch.
 - a) Manufacturer:
 - 1) Schuller
 - 2) Owens-Corning
 - 3) Approved Substitution

C. Blanket: Flexible form; faced, unfaced or coated as indicated.

 1. Duct insulation, external: Composed of flexible blanket of glass fiber factory laminated to a reinforced foil kraft (FRK) vapor retardant with a minimum 2 inch taping and stapling flange on one edge. Suitable for operation at temperatures from 40 degrees F. to 250 degrees F. thermal conductivity of 0.31 at 75 degrees F. Minimum density of 1-1/2 pcf. Provide in thickness of 2 inches unless otherwise indicated.

2. Finish Fabric, General Purpose: Nylon membrane. For use generally with fiberglass duct insulations at joints or seams or as indicated. Apply using Foster GPM 35-00 or equivalent.

a) Manufacturer:

- 1) Armstrong
- 2) CertainTeed
- 3) Childers Products Co.
- 4) Knauf
- 5) Schuller
- 6) Owens-Corning
- 7) Pittsburgh Corning

D. Preformed: Jacketed or unjacketed as indicated, one-piece or half-sectional.

1. Pipe insulation, preformed jacketed fiberglass: Jacketed with factory-applied kraft reinforced foil all-service vapor retardant jacket suitable for use in systems with temperatures from -60 to 350 degrees F. The jacketing shall have a white finish suitable for painting without sizing. Jacket closure system of factory-applied double pressure-sensitive adhesive on longitudinal joints; self-sealing butt strips at circumferential joints which provide closure and positive vapor retardant seal without hard rubbing or the application of heat. Thermal conductivity (K) of 0.24 at 100 degrees F. and vapor transmission of 0.02 perms.

a) Manufacturer:

- 1) Owens-Corning
- 2) Schuller
- 3) CertainTeed

2. Pipe insulation, preformed unjacketed fiberglass: Suitable for field-jacketing. Thermal conductivity (K) of 0.23 at 100 degrees F.

a) Manufacturer:

- 1) Owens-Corning
- 2) Schuller
- 3) Approved Substitution

2.4 INSULATION MASTICS AND ADHESIVE

a. Mastic: Low-odor, fire and vapor retardant mastic with permeance not exceeding 0.08 perms in accordance with ASTM E96. For use where indicated or otherwise applicable. Coating shall be non-flammable in both dry and wet states.

1. Manufacturer:

- a) Foster
- b) Childers
- c) Approved Substitution

2. Adhesive: For adhering fiberglass blanket and board insulations to metal substrate such as ductwork.

a) Manufacturer:

- 1) Insul-Coustic
- 2) Foster
- 3) Approved Substitution

2.5 INSULATION JACKETS AND COVERS

a. Jacket, Pipe, Aluminum: Aluminum jacketing, 0.016 inches thick, Type 3003 alloy, H-14 temper, circumferentially corrugated, with a continuously laminated moisture retardant of one mil polyethylene film and a protective layer of 40 lb. virgin kraft paper. Longitudinal jacket seams shall be provided with modified continuous Pittsburgh Z-lock located on the bottom half of the pipe to shed water.

1. Manufacturer:

- a) Childers Products Co
- b) General Aluminum Supply Co
- c) Insul-Coustic

b. Pipe Fitting Covers, Aluminum: Aluminum fitting covers, 0.020 inches minimum thickness, type 3003 alloy, H-14 temper prefabricated fitting covers with baked epoxy moisture retardant for pipe sizes through 24". Field fabricate fitting covers for pipe sizes larger than 24 inch using 0.020 inches thick aluminum roll jacketing with laminated polyethylene/kraft moisture retardant.

1. Manufacturer:

- a) Childers Products
- b) Approved Substitution

c. Pipe Fitting Covers, Reusable: Removable/Reusable covers for valves and strainers manufactured with a jacket of chemically-resistant silicon-coated fiberglass 6 pcf mechanically-bound ceramic fiber insulation for hot piping and fiberglass belting with "D"-ring belts. Use 3" foamglass for chilled water.

1. Manufacturer:
 - a) Superior
 - b) Approved Substitution

2.6 RELATED PRODUCTS

A. Wire: Dead soft, 16-gauge, stainless steel.

B. Straps: Stainless steel T-304 (18-8) soft annealed with deburred edge with stainless steel wing seals.

1. Manufacturer:
 - a) Childers Products
 - b) Approved Substitution

C. Tape: High tensile strength rope stock flat back paper pressure sensitive tape.

1. Manufacturer:
 - a) Pittsburgh-Corning
 - b) Approved Substitution

D. Screws: Aluminum pan head type "A" slotted #8 by 1/2 inch.

PART 3 - EXECUTION

3.1 GENERAL

A. Field Forming, Fitting and Finishing: Where preformed insulation products are available they shall be used. Provide field formed, fitted and finished insulation systems only if such application is more practical and acceptable to the Designer/OAR.

B. Pre-installation:

1. Prior to work of this section, carefully inspect the installed work of all trades and verify that all work is complete to the point where this installation may properly commence.
2. Insulation on pipe fittings, valves and pipe joints shall not be installed before the piping is tested and approved. Do not apply insulation adhesives, materials or finishes until the building is adequately closed in and the item to be insulated has been completely installed, tested and proved tight and suitable for insulation.
3. Remove all foreign material, clean and surfaces before applying insulation.

C. Penetrations: All insulation shall be continuous through walls, floors and ceiling openings, except at fire dampers. Pipe insulation through fire rated partitions shall be cellular foamglass type only, with the ends sealed; fiberglass and foam insulation through rated partitions is prohibited. Where piping and ducts pass through partitions (walls or floors), the openings in the construction around the piping and ducts shall be packed with fire-stop material to provide an effective retardant against the spread of fire, smoke and gases as shown in the detail drawings or as shown in a current Underwriter's Laboratory "Building Materials Directory". Submit a copy of the intended system to the authority having jurisdiction for their review and acceptance.

D. Vapor Retardant Continuity: A continuous, unbroken moisture and vapor seal shall be provided over insulation on cold surfaces where vapor retardant jackets, facings, or coatings are required. Anchors, hangers and other projections shall be insulated and vapor-sealed to prevent condensation. All openings and punctures shall be sealed with a vapor retardant compound. The edges of vapor retardant insulation at valve stems, instrument wells, gauge connections, unions and other raw edges shall be sealed to prevent moisture from penetrating the insulation by sealing on all open ends.

E. Workmanship: Insulation materials shall be installed in a workmanlike manner with smooth and even surfaces, with jackets drawn tight and smoothly cemented down at all longitudinal and end laps. Jacket and facing laps, joint strips and insulation ends, and straight runs of piping at not more than 21 foot intervals shall be secured and sealed with fire-retardant vapor retardant adhesive. Scrap pieces of insulation shall not be used where a full-length section will fit. All surface finishes shall be extended to protect all interfacing surfaces, ends and raw edges of insulation. Insulation on strainers shall be installed to facilitate cleaning of the strainer.

F. Hot Equipment Hanger Insulation: On all hot piping and equipment, hangers and supports may be attached to piping or equipment before insulation is applied, except where roller hangers are required.

g. Cold Equipment Insulation:

- 1. Hangers and Supports:** Insulation and jackets shall be neatly finished at pipe and duct hangers, clamps, anchors, and other supports which are in contact with the pipe or duct. Insulation shall consist of rigid pipe or duct insulation of equal thickness to the adjoining insulation, and shall be provided with a vapor retardant seal. The length of insulation shall be sufficient to prevent condensation but not be less than 9 inches.
- 2. Pipe Shields:** For cold piping, hangers and supports shall be installed on the outside of the insulation and the insulation shall be protected by a galvanized metal shield. Shield shall extend halfway up both sides of the pipe insulation cover and shall provide support over the bottom 120 degree arc of the insulation. If the hanger is too large to provide this support a metal liner shall be provided. The shield shall be fastened with pipe straps at each end. The insulation shields shall comply with the following table:

TABLE - PIPE INSULATION SHIELDS

Pipe Size, Inches	Metal Gauge	Length, Inches
1/2 to 1-1/2	18	12
2 to 4	16	12
6	16	18

Note: This table is based on an insulation with a minimum of 4 psi compressive strength and a maximum of a 10 foot span between hangers. Any modifications must be submitted for acceptance.

3. Trapeze Hangers: Insulated piping supported on trapeze hangers shall have a 6 inch long paraffin coated hard maple curved block between the saddle and the piping. The block shall be encased in the insulation exterior jacket or vapor barrier.

h. Valves, Cocks and Specialties: Insulate as for the related piping system in which they are located unless otherwise indicated.

i. Piping: Insulation thicknesses for piping are given for insulation installed at the locations indicated. Thicknesses are based on the various conditions of temperature, usage and environment which are typically encountered.

j. Insulation Over Nameplates: Cleanouts, nameplates, ASME labels and manholes shall not be insulated, and the insulation on surrounding surfaces shall be neatly beveled off at such openings.

k. Factory Pre-insulated Components: Where equipment and other system components are specified in other sections to have factory installed insulation, no additional insulation is required unless additional non-factory-installed insulation is specifically described.

l. Minimum Thicknesses: Insulation thicknesses which are indicated are minimum thicknesses. The same insulation material may be provided in greater thickness as an aid to installation and handling procedures or due to material availability and procurement considerations, as long as the additional thickness does not reduce critical clearances from other piping, walls, etc. and does not increase the thermal conductance.

m. Bands and Fasteners: Metal bands used on pipe insulation shall be 3/4" wide made from brass or aluminum. Bands shall be spaced to hold the ends and center of each section at a maximum spacing of 18 inches on centers. Bands shall not be visible on exposed work. Mechanical fasteners shall be installed in accordance with the manufacturers recommendations. Projecting points and sharp edges of fasteners shall not extend outside the insulation facing; clip off projecting points and provide plastic caps or cement cover finish.

3.2 ELASTOMERIC CELLULAR FOAM

A. Interior: Slip pipe insulation onto the piping before it is connected and seal the joints with adhesive. Where insulation cannot be slipped on, the insulation shall be slit lengthwise, applied to the piping, and sealed on all longitudinal seams and mitered butt joints. Insulation for fittings shall have sleeve-type covers made from miter-cut pieces of insulation of the same type as the adjacent piping. The inside of the fitting insulation must overlap the insulation on the adjoining piping.

B. Exterior: Provide insulation as detailed for interior use, except finish with weather-proofing coatings in accordance with the manufacturer's instructions.

C. Underground: Not acceptable.

3.3 GLASS FIBER PIPING INSULATION

A. Interior, Concealed: Insulate with glass fiber insulation with all purpose jacket. Elbows, joints, valves, and all like items shall be insulated using closely mitered insulation and wrapped with glass fabric secured with 20-gauge non-corrosive wire finished with a smoothing coat of insulating cement and mastic or insulated and jacketed using factory-made pre-molded pipe fitting covers. Install all items in strict accordance with the manufacturer's recommendations.

B. Interior, Exposed: Provide as specified for "Interior, Concealed", except where field-fabricated fitting covers are used. Additionally finish with open weave 20x10 mesh glass fabric adhered between two flood coats of white lagging adhesive, overlapping the adjacent pipe insulation 2" and smoothed to a neat uniform finish without noticeable ridges or exposed fabric. Finish materials shall be applied in strict accordance with the manufacturer's recommendations.

C. Interior, Exposed, Special Locations: Provide same as "Interior, Exposed" with the additional requirement that the final coat of mastic for the insulation finish shall be gloved and finished to accept painting.

D. Exterior, Protected: Provide the same insulation system as "Interior, Concealed" except thicknesses as specified. Cover finish with aluminum jacketing and fitting covers. Secure fitting covers with screws and secure jacketing with straps containing a high-temperature sealant.

E. Exterior, Unprotected: Provide the same as for "Exterior, Protected".

F. Underground: Not acceptable.

3.4 DUCT SYSTEMS

A. General: Air handling unit casings downstream of cooling coils shall be insulated. Insulate supply and return air ducts for heating and air conditioning systems from supply fan discharge to room outlets on all systems, and outside air ducts.

B. Interior, Concealed, External Insulation: Insulate with a minimum of 2 inch thick fiberglass blanket wrap applied over clean, dry sheet metal ductwork installed to allow maximum fullness at corners (avoid excessive compression). Adhere duct insulation to metal with 4 inch strips of insulation bonding adhesives on 8" centers or with adhesive applied in accordance with the manufacturer's recommendations. Where duct width exceeds 24 inches, the insulation shall be additionally secured to the bottom of the duct using mechanical fasteners spaced 1 foot on center to prevent sagging of the insulation. Insulation shall be applied with edges tightly butted, vapor retardant facing overlapped a minimum of 2 inch, and all joints and breaks in the vapor retardant sealed using glass fabric and mastic applied in conformance with manufacturer's recommendations.

C. Interior, Exposed, Round: Insulate with same insulation system as for "Interior, Concealed". An acceptable alternate is preformed jacketed fiberglass pipe insulation of the same internal size as the round ductwork, with performance criteria and installation as specified herein.

D. Interior, Exposed, Rectangular: Insulate with semi-rigid fiberglass board. Adhere to ductwork with adhesive. Finish joints and seams with finish fabric and mastic to provide a smooth, seamless and vapor-retardant finish.

3.5 DUCT SYSTEMS EQUIPMENT

A. General: Insulate as follows unless detailed to a greater extent elsewhere.

B. Fire damper and Fire/Smoke Damper External Surfaces:

1. **Externally Insulated Duct Locations:** Extend duct insulation and vapor barrier up face of fire damper to damper sleeve retaining angles. Seal insulation edges with 4 inch minimum width duct tape.
2. **Internally Insulated Duct Locations:** Provide additional external insulation from a point on the duct 12 inches from the fire damper to the fire damper and on the face of the fire damper to the fire damper sleeve. Seal insulation edges with 4 inch minimum width duct tape.

C. Duct Accessories: Where ducts will be insulated, make provisions for neat insulation finish around damper operating quadrants, splitter adjusting clamps, access doors, and similar operating devices. A metal collar equivalent in depth to insulation thickness and of suitable size to which insulation may be attached and finished shall be mounted on the duct.

3.6 COLD EQUIPMENT AND RELATED COMPONENTS

A. Condensate Drain Piping From Cooling Equipment:

1. **Interior; and Exterior, Protected:** Insulate with preformed elastomeric pipe insulation secured with adhesive and finished with a white finish coating.
2. **Exterior, Unprotected:** None required.

B. Flexible Pipe Connectors for Vibration Isolation: Insulate with elastomeric insulation. Secure the insulation with adhesive applied to a clean surface and finish with white finish coating.

3.7 REMOVABLE INSULATION

A. Equipment Insulation Covering: The covering on parts of equipment which must be opened for inspection, cleaning and repair shall be constructed to be removed and replaced without damage. Covers shall be installed as complete units or in sections and shall have metal fastenings and all necessary support frames and members. Equipment to be covered shall be in insulated boxes of thicknesses specified; the boxes shall be held and drawn together by bolts. Insulation shall be protected by means of metal bands around each section formed to provide a vapor-sealed telescopic fit at the joints between the sections. Cut, score or miter insulation to fit the contour of the equipment and secure with 1/2 inch x 0.015 inch galvanized steel bands or 15-gauge galvanized wire on 12 inch centers. Weld pins or stick clips with washers may be used for flat surfaces when spaced 18 inch apart. Joints shall be staggered where possible, and voids shall be filled with insulating cement. One of the following finishes shall be provided:

1. Apply 1 inch galvanized wire mesh over the entire surface and finish with two coats of

- insulating cement troweled to a hard, smooth finish, with a minimum coat thickness of 1/8 inch per coat;
2. Apply a smoothing coat of insulating cement. When dry, apply a coating of lagging adhesive, and imbed a layer of open weave 20x10 glass cloth, overlapping all seams of 2 inch and finish with a second coat of same adhesive, with a minimum coating thickness of 1/4 inch;
 3. Insulation with factory-applied Universal Glass Cloth vapor retardant needs no additional finish. Joints in factory-applied facing shall be covered with 4 inch wide strips of the same material and cemented in place.

3.8 MISCELLANEOUS ITEMS

A. General: Provide insulation of any portion of a system or piece of equipment not previously discussed where ambient operating conditions will allow condensation to occur or whose surface temperature exceeds 115 degrees F. Insulation materials and method shall be as directed by the Designer.

B. Final Inspection: At final inspection the finished surfaces of all exposed insulation shall be clean and without stains or blemishes. Repair and clean the insulation surfaces and, if necessary to obtain a new appearance, shall coat discolored surfaces with off-white latex water-base semi-gloss paint or lagging adhesive, without a change in the contract price.

END OF SECTION 23 07 00

SECTION 23 08 00 - PERFORMANCE VERIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Basic Requirements: Provisions of Section 23 05 01, BASIC MECHANICAL REQUIREMENTS, are a part of this Section.

1.2 SUMMARY

A. General: The Contractor will select and pay for the services of a test and balance agency (herein referred to as the T&B Agency) for system and equipment performance verification.

b. Scope: Verifying the performance of the complete heating, ventilation and air conditioning systems of Division 23, by testing and balancing procedures described in this section.

1.3 APPLICABLE STANDARDS

A. All equipment, material, accessories, methods of construction and reinforcement, finish quality, workmanship and installation shall comply with Section 23 05 01.

1.4 TEST AND BALANCE AGENCY

A. General: Performance verification shall be performed by an independent T&B Agency.

B. Certification: The T&B Agency shall be a certified member of the Associated Air Balance Council (AABC) or the National Environmental Balancing Bureau (NEBB).

C. References: The T&B Agency shall have been in business continuously for the previous three (3) years and shall specialize in and be limited to testing and balancing HVAC systems. The T&B Agency shall submit references of five previously successfully completed projects of similar size, type, scope, and complexity.

D. Supervision: Field work shall be performed under the direct supervision of a full-time employee of the T&B Agency. The final test reports shall be certified and sealed by the supervisor and signed by the employees performing the work.

E. Approval: The T&B Agency shall not be affiliated with the construction contractors, equipment manufacturers, sales vendors, or design engineering firms. Schedule all test and balancing work in cooperation with the T&B Agency and at the direction of the Owner. The T&B Agency shall report to the Designer in writing anytime the scheduled services cannot be performed as schedule or as required. All equipment shall be operational during the test and balance process.

F. Reporting: The T&B Agency shall function as an authorized inspection agency responsible to the Owner, and shall list all items which are installed incorrectly, require correction or completion, or which have not been installed in accordance with the contract documents. Prior to beginning system balancing, submit to the Designer for the Owner's review, written procedures to be followed for the testing and balancing work.

1.5 INSTRUMENTATION

a. General: All test and balance equipment and instruments shall be furnished by the T&B Agency and shall have been calibrated to the tolerances required in balancing standards within six (6) months of use on this work. A list of equipment and instruments shall be submitted to the Designer for the Owner's review prior to commencing test and balancing operations and shall include manufacturer, serial number and certification of last calibration date and method of calibration including test references. Instruments without calibration adjustment capability shall be accompanied with manufacturer's certification of accuracy. Instruments shall have maximum field measuring accuracy, shall be applied as recommended by the manufacturer, and shall have minimum scale and maximum subdivisions with ranges for the values being measured.

1.6 WORK INCLUDED

a. General: The T&B Agency shall provide all labor, supervision, professional services, tools, test equipment and instruments (except as otherwise indicated) to perform work of this section; including but not limited to:

1. Review the temperature control and equipment specifications for their effects on the testing and balancing procedures for the air systems.
2. Where conditions may exist in the system design or construction which may adversely affect system performance, identify the conditions and submit recommended corrections in writing for consideration by the Designer.
3. During construction, review shop drawings relevant to performance verification to confirm that the required piping, ductwork and equipment, and their respective specialties and accessories such as gauges, valves, dampers, access doors, etc., are properly selected, sized and located to permit proper and complete testing and balancing.
4. Perform a complete air test and balance of all heating, ventilating, air conditioning and exhaust air systems described on the Contract Documents.
5. Submit the Equipment Test and Systems Balance Report for review and acceptance.
6. Furnish specifications for properly-sized fixed sheaves and belts on fan systems after proper RPM has been established.
7. Test for sound and vibration levels.
8. Test and report pressure differentials between the sampling and return ports of all duct smoke detectors.

1.7 GUARANTY

a. General: The T&B Agency shall include a warranty period of ninety (90) days after acceptance of test and balance work. During the warranty period, the Owner may request a re-check or re-setting of any system component requiring testing and balancing. The T&B Agency shall provide technicians, instruments, and tools to assist the Owner in conducting any test required. A guarantee, such as the AABC National Project Certification Performance Guarantee, shall also be provided.

PART 2 - PRODUCTS

2.1 REPORT

A. Records: Recorded test data shall be at the final balanced condition for each system, and shall be arranged by system using the appropriate designation as established on the Contract Documents. Six (6) copies of the typewritten, signed, bound and indexed final report shall be submitted to the Owner review prior to request for substantial completion inspection. The substantial completion inspection shall not be scheduled until the final report has been received and is acceptable to the Owner. Report format shall be similar to forms approved for use by SMACNA or AABC.

B. Measurements: Where actual measurements recorded for the final balance show deviations of more than five (5) percent from the design, the T&B Agency shall note same in the report and submit recommendations for corrective action to the Owner.

C. Deficiency: Where recorded data can be reasonably interpreted to be inaccurate, inconsistent or erroneous, the Owner may request additional testing and balancing. The T&B Agency shall perform retesting and re-balancing at no additional cost.

D. Vibration: Where, in the opinion of the T&B Agency, there is excessive vibration, movement or noise from any piece of equipment, ductwork, pipes, etc., the T&B Agency shall note same in the report and submit recommendations for corrective action to the Owner.

E. Controls: The T&B Agency shall verify that each controller and the devices it controls, such as control valves, motorized dampers, etc., operates in the exact sequence required.

F. Test Data: Include the following data in the Systems Test and Balance Report:

1. Motors:

- a) Manufacturer**
- b) Model and serial number**
- c) Rated amperage and voltage**
- d) Rated horsepower**
- e) Rated RPM**
- f) Measured amperage and voltage**
- g) Calculated brake-horsepower**
- h) Measured RPM**
- i) Sheave size, type and manufacturer**
- j) Bearing model numbers**

2. Fans:

- a) Manufacturer**
- b) Model or Serial number, type of fan, number of blades, wheel diameter**
- c) Rated CFM, measured CFM**
- d) Rated RPM, measured RPM**
- e) Design inlet and outlet total and external static pressures**
- f) Actual inlet and outlet total and external static pressures**

- g) Pulley sizes, types and manufacturers
 - h) Belt size and quantity (V-belt drive only)
 - i) Bearing model numbers
3. Air Systems (including inlets and outlets):
- a) Grille or diffuser reference number, manufacturer and type
 - b) Grille or diffuser location
 - c) Design and measured velocity
 - d) Design and measured CFM
 - e) Effective area factor and size, and diffuser flow coefficients
 - f) Terminal Unit CFM
 - g) Tabulation of design and measured CFM for each inlet or outlet
 - h) A summarization by system to compare design data to actual
4. Air Handling Units:
- a) Design and measured air flow rates
 - b) Design and measured airside static pressure drops across each coil and across the entire unit
 - c) Design and measured airside cooling coil entering and leaving dry and wet bulb temperatures
 - d) Design and measured airside heating coil entering and leaving dry bulb temperatures

G. Other Report Requirements: Where systems have equipment or components which are not covered by the above, the Final Test and Balance Report shall include the following design and measured data as applicable:

- 1. All duct inlet and outlet areas.
- 2. All applicable duct, pipe and coil sizes
- 3. Outside, return, mixed and supply air conditions.
- 4. All fluid velocities, flow rates, temperatures and pressure differentials at appropriate locations.
- 5. All speeds.
- 6. All voltage and ampere ranges.

PART 3 - EXECUTION

3.1 GENERAL

A. Load Conditions: All testing and balancing of systems shall be performed with maximum attainable load. Testing and balancing of all air handling systems shall be accomplished with ceiling tiles in place and enclosing partitions, windows and doors erected.

B. Observation: Observe all equipment and exposed piping for noise, movement or vibrations under normal operating conditions and report unacceptable operation to the Owner.

C. Measuring Stations: Where measuring stations are installed, each is to be read and recorded in hydronic systems, permanent devices such as flow tubes with manometers, annular ring systems, venturi tubes with portable meters, etc. must be used for final measurements after they are completed and calibrated.

d. Adjusting: Testing and balancing is an iterative process and the T&B Agency may have to perform preliminary adjustments, readjustments and final adjustments as necessary to properly tune the systems. This is an integral part of the balancing procedure and must be anticipated; all adjustments, spot-checking required by the Owner and other re-verification shall be performed at no additional cost to the Owner.

3.2 AIR SYSTEMS

A. General: The testing and balancing shall include, but is not limited to, the following requirements:

1. Adjust fan speeds to deliver the required CFM and static pressure, and record rpm and full load amperes. Replace drives as required; increasing static pressure by dampering at the fan is not permitted.
2. Traverse main supply ducts with pitot tube to verify design CFM. Artificially load air filters by partially blanking to produce the equipment or air pressure drops through dirty filters. Mark position of balancing devices.
3. Verify the quantity of outside air and return air when the system is operating in the maximum cooling and full heating modes. Check all controls which regulate flow or pressure for calibration, verify damper positioning and modulation, and flowrate with minimum and maximum outside air.
4. Test and adjust each diffuser, grille and register to within five (5) percent of design requirements, and adjust to minimize drafts and noise in all areas.
5. Observe all equipment and exposed ductwork for noise, movement or vibration under normal operating conditions and report to the Designer.

b. Air Distribution: Adjust air distribution devices to distribute design air quantities. Should the temperature in any area vary more than two (2) degrees from the zone thermostat setpoint, notify Designer and obtain approval to re-balance devices to air quantities other than those indicated so that air temperature in the entire zone will be as even as possible regardless of design air quantities. After obtaining approval, perform necessary re-balancing.

3.3 SYSTEM MEASUREMENT

a. General: Measurements shall be taken to obtain accurate and consistent readings; i.e., sufficiently downstream from changes in direction, regions of turbulence, or flow convergence.

b. Repeatability: Take sufficient readings which when averaged will result in a repeatability error not to exceed five (5) percent. When measuring a single point, repeat readings until two consecutive identical values are obtained. Readings shall be taken with the eye at the level of the indicated value to prevent parallax. Insert pulsation dampeners to eliminate error involved in estimating the median of fluctuating readings.

END OF SECTION 23 08 00

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SECTION 23 21 13 - PIPE AND FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

a. Basic Requirements: Provisions of Section 23 05 01, BASIC MECHANICAL REQUIREMENTS, are a part of this Section.

1.2 SUMMARY

a. General: Provide and install pipe and fittings as indicated and including all offsets, fittings, sleeves and similar items required but not necessarily indicated due to drawing scale for complete and operable systems.

1.3 SUBMITTALS

a. General: Provide shop drawing and manufacturer's data sheet for the following items:

1. Manufacturers Literature:

- a) Complete design and construction data for dielectric unions and flanges.
- b) Complete design and construction data for no-hub couplings.
- c) Complete design and construction data for grooved mechanical fittings and couplings for steel piping systems.
- d) Complete design and construction data for grooved mechanical fittings and couplings for copper piping systems.
- e) Manufacturer's data on piping and fittings used, with an indication of each specific application

2. Performance Data: Submit a copy of the Welding Procedure Specification with the Procedure Qualification Record and certificates of the welders and welding operators required by Section IX of the ASME Boiler and Pressure Vessel Code.

3. Installation Data:

- a) Manufacturer's printed installation instructions for no-hub couplings.
- b) Manufacturer's printed instructions for the installation of grooved mechanical fittings and couplings for steel pipe.
- c) Manufacturer's printed instructions for the installation of grooved mechanical fittings and couplings for copper pipe.
- d) UL approval number, installation materials, and procedures for pipe penetrations of fire-rated walls and floor.

1.4 APPLICABLE STANDARDS

a. General: All equipment, material, accessories, methods of construction and reinforcement, finish quality, workmanship and installation shall be in compliance with the applicable standards and codes listed in paragraph entitled "Code Compliance" in Section 23 05 01.

b. Quality and Weight: The quality and weight of materials shall comply with requirements and specifications of the appropriate standards of the American Society of Testing and Materials, American National Standards Institute, American Society of Mechanical Engineers, and the American Welding Society.

c. Piping System: All pressurized piping systems shall conform to ASME B31.9, Code for Pressure Piping, Building Services Piping. All piping systems with services exceeding 250°F. 160 psig and steam and condensate exceeding 15 psig shall meet ASME B13.9, Power Piping.

d. Welder Certification: Welders shall be tested and certified within the last 2 years by the National Certified Pipe Welding Bureau or recognized testing agency acceptable to the Designer. Competent certified welders shall perform all welding operations. Each welder shall possess a stamp to identify his work and shall stamp each weld. A copy of the certification shall be available at the jobsite for each welder.

e. Welding Installation: Welding shall be in accordance with the welding procedures and requirements set forth in "Welding of Pipe Joints" of the "Code for Pressure Piping" in the American Welding Society Welding handbook. Pipe welding shall comply with the provisions of the latest revision of the applicable code, whether ASME Boiler and Pressure Vessel Code, ANSI Code for Pressure Piping, or state or local requirements as may supersede these codes.

f. Brazing: Brazing of copper tubing shall be in accordance with the standards of the American Welding Society, the Copper Development Association Copper Tube Handbook instructions on brazing, and ASME Boiler code Section IX.

g. Soldering: Soldering of copper tubing shall be done in accordance with the Copper Development Association, Copper Tube Handbook instructions on Joining and Forming Copper Tube, Soldered Joints.

h. FMRC: No-hub couplings shall be in compliance with Factory Mutual Research Corporation Standard 1680-89.

i. PVC-DWV: The use of PVC-DWV piping shall be permitted only if written approval is obtained from the local authority having jurisdiction. The written approval shall be included with the submittal of the manufacturer's literature.

PART 2 - PRODUCTS

2.1 GENERAL

a. Application: This section covers the material and installation of various pipe and fittings which may be indicated in other sections of these specifications for use in a specific piping system. Pipe and fittings specified in this section may not be substituted in piping systems for the specific pipe and fitting materials indicated in those individual sections of these specifications.

b. Fittings: Fittings shall be at a minimum the same gauge as the connected piping, and shall be compatible with the piping material (i.e., galvanized fittings on galvanized pipe.) The use of field-fabricated fittings is prohibited.

c. Lead Content: Pipe, fittings or any other piping device which includes any lead in the alloy shall not be used in any potable water system.

d. Connection of Different Pipe Materials: Where different types of above ground pipe material or different weights or schedules of pipe are joined, provide a stainless steel coupling with an elastomeric gasket for the connection. The coupling shall incorporate a full-length shield of 304 stainless steel, with bolts manufactured of 304 stainless steel which tighten the shield around the gasket to provide a solid connection.

2.2 STEEL PIPING

a. Pipe: Black steel pipe shall be seamless or electric resistance weld for pipe sizes 2 inch and above, continuous weld below 2 inch, conforming to ASTM A 53-89a Grade B, ASTM A 106 Grade B, or ASTM A 120 Grade B. Galvanized pipe shall conform to ASTM A 53-89a. Unless otherwise noted, black and galvanized steel pipe smaller than 12 inches shall be schedule 40 and pipe 12 inches and larger shall be standard schedule. The ASTM number shall be marked on each length of pipe.

b. Schedule 10: Black steel schedule 10 pipe shall be continuously-welded and in conformance to ASTM A-135.

c. Fittings:

- 1. Threaded Fittings:** Malleable iron 150 lb. or 300 lb. class conforming to ASTM A-47 and ANSI B16.3, or cast iron 125 lb. or 250 lb. class conforming to ASTM A-234 and ANSI B16.4. Threads shall conform to ANSI B1.20.1, standard pattern.
- 2. Pipe Nipples:** Provide nipples of same material as pipe schedule 80. Threads shall comply with ANSI B1.20.1. Nipples shall not be threaded full-length (no close nipples).
- 3. Welded Fittings:** Forged, seamless, black steel, long radius, conforming to ANSI B16.11 for socket-type welds and ANSI B16.9 for butt-type welds. Weldolet fittings may be used in lieu of forged tees where branch connections are not larger than three-quarters the size of main pipe, except on piping 2 inch and smaller, where forged fittings shall be used exclusively. Mitred elbows, tees and reducers are prohibited.
- 4. Unions:** Unions shall be malleable iron or steel with ground joint on piping 1-1/2 inch and smaller; flanges shall be used on sizes 2 inch and larger. Unions shall conform to ANSI B16.39 with ANSI B1.20.1 threads and shall have hexagonal ball-and-socket joints with bronze metal-to-metal seating surfaces, female ends, and a seat ring pressed into the headpiece so it cannot be forced out.
- 5. Couplings:** All couplings shall be taper tapped. Couplings shipped with pipe are not acceptable.
- 6. Flanges:** Forged carbon steel, welding neck type and lap joint conforming to ANSI B16.5. Flanges shall have raised face and gaskets with bolt spacing for the required pressure classification. Gasket material shall be ring-type, 1/16 inch thick compressed heat-resistant fiber or neoprene; gasket shall not contain any asbestos. Flange bolts shall conform to ASTM A307 hex bolts, with ANSI B18.2 hex nuts. Black steel flanges shall have galvanized steel bolts and nuts; galvanized steel flanges shall have galvanized steel bolts and nuts.
- 7. Grooved Mechanical Fittings and Couplings:** Mechanical pipe couplings for steel pipe shall be self-centering and shall engage and lock in place the grooved or shouldered pipe and pipe fitting ends in a positive watertight couple. Mechanical couplings shall

have a central cavity pressure-responsive housing fabricated in two or more parts of malleable iron castings in accordance with ASTM A47, or ductile iron in accordance with ASTM A536; where pipe is galvanized, couplings shall be galvanized. Mechanical fittings shall be malleable or ductile iron conforming as specified above, or shall be manufactured for fabricated steel complying to ASTM A53 or ASTM A106. Couplings shall have two or more nuts with electroplated oval type ASTM A183 bolts, locking pins, toggles, or lugs as required to secure grooved pipe and fittings. Housing clamps shall hold in place a composition water-sealing gasket designed to allow internal water pressures serve to increase the watertightness of the seal. Gaskets shall be neoprene or EPDM and suitable for use to 230 degrees F. Rigid couplings shall be used for rigid joints, otherwise use flexible-type couplings.

a) Manufacturer:

- 1) Victaulic Company of America
- 2) ITT Grinnell Gruvlok
- 3) Tyler Pipe
- 4) Central Sprink, Inc.

2.3 COPPER ALLOY PIPING

a. Pressure Pipe: Copper piping shall be annealed seamless hard temper type "K", "L" or "M" as indicated and shall comply with ASTM B-88. Copper is allowed for pipe sizes up to and including 4 inch diameter. The name or trademark of the manufacturer and the type of pipe shall be permanently marked on each section of pipe at intervals not exceeding 4-1/2 feet.

b. Refrigerant Piping: Refrigerant piping shall be seamless annealed copper tubing complying with ASTM B280.

c. Drainage Pipe: Non-pressure piping shall be copper type DWV, hard temper and conform to ASTM B306.

d. Brass Pipe: Chrome-plated brass piping shall be schedule 40 conforming to ASTM B43.

e. Fittings:

1. **General:** Fittings used in copper alloy piping shall be streamlined pattern, wrought or cast brass conforming to ANSI B16.22 or wrought bronze conforming to ANSI B16.15.
2. **Flare Fitting:** Flare fittings shall be used on soft copper tubing, and shall comply with ANSI B16.26.
3. **Union:** Unions in 2 inch and smaller copper alloy piping shall be brass or bronze, ground joint for solder connection with hexagonal ball-and-socket joints, bronze metal-to-metal seating surfaces, female ends, and a brass seat ring pressed into the headpiece so it cannot be forced out.
4. **Flanges:** Flanges shall be used in copper alloy piping larger than 2 inch, and shall comply with ANSI B16.24. Flanges shall have raised face and gaskets drilled for the pressure (class 150 or 300 lb) as required. Gasket material shall be ring-type, 1/16 inch thick compressed heat-resistant fiber or neoprene; gasket shall not contain any asbestos. Flange bolts shall be brass and conform to ASTM A307 hex bolts, with ANSI B18.2 brass hex nuts.

5. Mechanical Couplings: Rolled-groove mechanical couplings and fittings may be used in lieu of solder joints where indicated.
6. Dielectric Isolator: Dielectric couplings shall be rated for at least 150 percent of the maximum working pressure of the piping system and at least 50 degree F. higher than the maximum operating temperature of the piping system in which they are installed. Couplings shall be electroplated steel or brass with inert and non-corrosive thermoplastic lining, or bronze fittings.
 - a) Union: Provide dielectric insulating unions in piping 2 inch and smaller with threaded or solder joint connections.
 - b) Flanges: Flanged dielectric insulating sets shall be used for pipe sizes 2-1/2 inches and larger. Flanged insulation sets shall have phenolic retainer, nitrile rubber seal element, polyethylene sleeves and double washer.
 - c) Manufacturer:
 - 1) Epco
 - 2) Watts
 - 3) Eclipse
 - 4) Grinnell
 - 5) Victaulic

A. Drainage Fitting: Fittings for copper DWV shall be cast bronze or wrought copper solder joint DWV drainage fittings complying with ANSI B.16.23 and B.16.29.

2.4 SPECIAL PIPE MATERIALS

A. PVC: Type PVC-DWV pipe and fittings shall conform to ASTM D2665-85, NSF Seal of Approval, solvent-cement joint.

B. PVC: Schedule 40, 80 or 120 PVC piping shall conform to ASTM D1785, socket fittings shall conform to ASTM D2466; threaded fittings shall conform to schedule 80, ASTM D2464.

C. CPVC Piping: Chlorinated Polyvinyl Chloride (CPVC) piping shall conform to ASTM D2846.

D. PVDF: Pipe, fittings and valves shall be manufactured of natural, unpigmented, virgin, and non-compounded Polyvinylidene Fluoride (PVDF) in standard schedule 80 pipe dimensions unless otherwise indicated. Pipe, fittings and valves shall be socket heat-fusion type, and shall conform to ASTM D-2457, with tolerances in accordance with ASTM D-1785.

E. ABS: ABS (Acrylonitrile-Butadiene Styrene) DWV pipe and fittings shall conform to ASTM D-2661; ABS sewer pipe and fittings shall conform to ASTM D-2751.

F. Plastic to Metal Transitions: Plastic and metal pipe shall be joined by flanges or unions specifically manufactured for the purpose.

G. Ductile Iron Piping: Ductile iron piping shall be class 52. Cement-lined ductile iron piping shall be class 52, with fittings of class 250 cement-lined ductile iron construction. Mechanical joint ductile iron pipe shall conform to ANSI/AWWA C151/A21.51. Mechanical joint shall be stuffing box type construction consisting of a bell with a flange integrally cast, a gray or ductile iron gland, rubber

gasketing, and steel bolts and nuts. The bolts used shall be cathodic to the pipe to minimize corrosion.

2.5 JOINT FILLER MATERIALS

A. Solder: Solder containing lead shall not be used in potable water piping; only 95% tin - 5% antimony (95/5) or silver brazing (no substitutions) are acceptable for solder joints in potable water piping. 95/5 and 50/50 tin-lead solder shall conform to ASTM B32.

B. Brazing: Brazing (silver solder) material shall conform to AWS A5.8, classification BAg 1.

C. Welding: All electrodes shall conform to AWS Standards E-6010, E-7010, E-7018 or E-8018-B2, C2, or C3 as applicable.

PART 3 - EXECUTION

3.1 GENERAL

A. Installation: Pipe and fittings shall be installed as specified in this section unless specific installation instructions are provided in the individual sections covering the piping system. Install each run with a minimum of joints and couplings, but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Reduce sizes where indicated using reducing fittings. Align piping at connections within 1/16 inch misalignment tolerance.

B. Routing and Placement: Piping shall be run without traps or pockets and pitched a minimum 1 inch per 40 feet in the direction of flow, unless indicated or required to be pitched steeper. Grade piping so that air in the mains and risers will be carried up and discharged at venting points. Coordinate installation with structural features, and with other piping, equipment and the work of other trades. All piping shall be installed as close to the structure overhead as possible.

C. Prohibited Installation: Do not run piping through transformer vaults, elevator equipment rooms, other electrical or electronic equipment spaces and enclosures. Do not run piping over electrical panels. Where pipe joints or valves in water lines occur within two feet in horizontal directions from electrical panels or equipment, provide drip pans sized to afford protection. Pans shall be 20-gauge galvanized steel with edges turned up 2-1/2 inches on all sides, reinforced with galvanized steel angles or by rolling edges over 1/4-inch diameter steel wire. Provide a drain with 3/4-inch flange and pipe to nearest floor drain, and support the pan assemblies as required to prevent sagging or swaying.

D. Interior Piping: Interior piping shall be run parallel to the walls and ceilings; avoid diagonal runs. Provide a minimum 6 inch clearance between walls and horizontal piping.

E. Exterior Piping: Exterior piping (above and below grade) shall essentially be routed and located as indicated on the drawings; however, actual placement shall be verified by confirming exact location of structures and other utilities in the field and by careful layout prior to execution of the work.

F. Insulated Piping: Pipe requiring insulation shall be installed with sufficient clearances to permit proper application of insulation.

G. PVC Pipe: PVC piping, fittings and other PVC materials shall not be installed in air conditioning plenums or equipment rooms used as air conditioning plenums.

H. Cast Iron Pipe: Unless otherwise indicated, install 3 inch and larger horizontal storm and waste piping with 1/8 inch per foot slope; piping 2-1/2 inch and smaller shall be installed at a slope of 1/4 inch per foot. Run horizontal vent lines to a minimum grade back to stacks and vertical vent lines as direct as possible.

I. Drains: Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4 inch ball valve, and short 3/4 inch threaded schedule 80 nipple with hose end and cap.

J. Tool Marks: Copper, brass and chromed, polished or painted piping, fittings and connections to fixtures shall not show tool marks. Replace damaged piping and fittings.

K. Potable Water Solder Joints: Samples of solder in potable water piping may be taken from completed joints and tested for lead. If tests indicate lead, the joints will be condemned and all fittings, valves and pipe ends shall be replaced with new materials where such joints occur at no cost to the Owner.

3.2 EXPANSION AND CONTRACTION

A. Provision for Expansion: Piping shall be installed with provisions for expansion both horizontally and vertically in all long runs including runouts from risers. Expansion loops and expansion elbows shall be provided for expansion and contraction where required and where shown on the drawings.

B. Cold-Springing of Pipe: Cold-spring hot piping systems to reduce the amount of thermal expansion of the piping.

C. Pipe Anchors: Provide pipe anchors as indicated or as required to eliminate excessive piping movement in thermal and pressure piping systems.

3.3 UNDERGROUND PIPING

A. Cover and Excavation: Minimum cover for exterior underground piping is three feet over insulation or pipe unless otherwise indicated. See Article entitled "PROTECTION" in this section for uninsulated underground piping protection.

B. Thrust Blocks: Provide properly sized and placed thrust blocks at all fittings in water and fire mains pressure pipe at every change in direction or where required. Thrust blocks shall bear on and against undisturbed or properly compacted soil. Provide temporary thrust blocking for testing at piping end points and other points as required.

C. Water and Sewer Separation: Underground water piping and building sewer shall be separated with undisturbed or compacted earth at least 10 feet horizontally if installed at the same level or lower than the sewer. Where potable water piping is closer than 10 feet to a sewer line, place the bottom of the water pipe at least 18 inches above the top of the sewer or the sewer shall be encased in a concrete envelope as required.

D. Identification Tape: Place a color-coded 6 inch wide, 0.004 inch thick polyethylene printed plastic identification tape directly above all underground piping systems at approximately 12 inch below finished grade. Tapes shall be continuously printed with "CAUTION" in large bold letters, and the type of service piping shall be indicated on the second printed line.

3.4 JOINTS AND CONNECTIONS

A. General: Align all pipe before joints are made. Joints and connections shall be air, gas and water tight.

B. Steel Pipe Joints: All pipe joints up to 1-1/4 inch shall be threaded; joints in pipe 1-1/2 inch and 2 inch may be socket-type welded or threaded; pipe 2-1/2 inch and larger shall be butt fusion welded.

C. Welded Joints: All welds shall be first quality metal, thoroughly fused to the base metal at all points, free of cracks, oxidation, blow holes and nonmetallic inclusions. The welder shall leave his indelible identifying mark on the piping adjacent to each weld.

D. Testing of Welded Joints: The Designer/OAR may visually spot check welding work anytime. The OAR may also employ an outside testing agency to analyze any of the welded joints for imperfections. All welded joints found by inspection or testing to have imperfections shall be repaired.

E. Threaded Joints: Use ANSI B2.1 threaded joints in piping with a minimum wall thickness of Standard Schedule pipe. Assemble the joint wrench-tight, applying force on the end of the fitting into which the pipe is being joined. If a seam fails during cutting or threading, that portion of pipe shall be discarded. Threaded joints shall have a minimum of 3 threads engaged and a maximum of 3 threads exposed.

F. Solder Joints: Solder joints shall be used on pipe 2-1/2 inches and smaller. Unless otherwise noted the following solder material shall be used:

1. For operating pressures up to 125 psig, 95/5 solder.
2. For operating pressures above 125 psig, silver brazing alloy.

G. Brazed Joints: Solder joints in piping 3 inches and larger, and as otherwise indicated, shall be brazed. Remove stems, seats and packing of valves and accessible internal parts at piping specialties before brazing. Fill the pipe and fittings during brazing with an inert gas (i.e., nitrogen or carbon dioxide) to prevent the formation of scale. Heat joints to a uniform temperature and form a liquidtight circumferential joint seal.

H. Dissimilar Metals: Dielectric unions or flanges shall be provided at all junctions of copper or brass pipe or fittings and ferrous material to prevent electrolysis and galvanic corrosion. Where copper or brass tubing or fittings are anchored, supported, or may come in contact with ferrous piping system materials, isolate the two materials with a non-conducting neoprene spacer.

I. Flanges: Connect pipe flanges to pipe ends in accordance with ANSI B31.1.0 Code for Pressure Piping; clean flange faces and install gaskets. Using a torque wrench, tighten flange to the torque specified by the manufacturer of the flange to provide uniform compression of gaskets.

J. Cut-Grooved Mechanical Couplings for Steel Pipe: Pipe grooving shall be in accordance with the pipe coupling manufacturer's recommendations. Piping shall be cut-grooved, except where indicated. Pipe wall thickness shall be a minimum of Standard Schedule. Before the assembly of couplings, lightly coat the pipe ends and the outside of gaskets with cup grease or graphite paste to facilitate installation. Tighten bolts or lugs to the proper torque as directed by the manufacturer to provide a watertight joint.

K. Rolled-Groove Mechanical Couplings for Copper Pipe: Pipe grooving shall be in accordance with the pipe coupling manufacturer's recommendations. Piping shall be rolled-grooved without removal of any metal. Before the assembly of couplings, lightly coat the pipe ends and the outside of gaskets with approved lubricant or silicone to facilitate installation. Tighten bolts or lugs to the proper torque as directed by the manufacturer to provide a watertight joint.

L. No-Hub: Insert ends the full depth of the gasket. Slide the coupling housing over the gasket, and tighten the clamp to the torque recommended by the joint manufacturer. When special torque wrenches are provided for a joining system, joints shall only be made with these wrenches. Provide one spare special torque wrench to the Owner prior to final acceptance. No-hub fittings shall not be used on underground piping or for pipe sizes larger than 10 inches.

M. Mechanical Joint Ductile Iron Pipe: Follow manufacturer's instructions for lubricating the pipe ends to be joined. Insert plain end into socket end; seat gasket evenly and watertight; affix gland into position and tighten bolts to torque requirements as recommended.

N. Plastic Pipe: Pipe and fittings to be joined by solvent cement shall be wiped clean with a cloth moistened with acetone or methyl-ethyl ketone, in accordance with ASTM D2855. Apply joint compound to the male threads of screwed fittings. Provide horizontal and vertical support spacing in compliance with the manufacturer's requirements and local codes.

O. Rated Penetrations: Provide UL-approved method of sealing fire- and fire/smoke rated wall and floor penetrations. Submit method proposed prior to installation.

P. Underground Piping: Underground piping connections for different types of piping material shall be limited to grooved coupling, dresser coupling, matching flanges, or mechanical joint with retaining rods.

3.5 EQUIPMENT CONNECTIONS

A. General: Make connections between equipment and piping system with unions, flange joints or other fittings which permit equipment to be disconnected and removed for maintenance. Connections to equipment shall be made in accordance with details on the drawings and the equipment manufacturer's installation instructions. Final connections to equipment shall be made with unions for pipe sizes 2 inch and under and with flanges for pipe sizes over 2 inches.

B. Locations: Provide unions or flanges where indicated, and in the following locations even if not indicated:

1. In long runs of straight piping for water and other non-gaseous services at 60-foot intervals to permit convenient disassembly for alterations and repairs.
2. In bypasses around equipment.

3. In connections to in-line equipment requiring disconnection for repairs and replacement, located between the isolation valve and the equipment.
4. Within 3 inches of each threaded valve and each piece of equipment not having unions or flanges attached.

3.6 PIPE SIZE REDUCTIONS AND ENLARGEMENTS

A. Prohibited Fittings: Screwed bushings are prohibited, except where available space prevents use of reducing couplings

B. No-Hub Clamps: No-hub clamps with bushings shall not be used for pipe size reduction. Cast iron fittings are required.

C. Reducing Couplings: Eccentric reducing couplings shall be installed throughout water piping to prevent air or water pockets occurring due to a change in pipe size. Eccentric couplings on water lines shall bring the pipes flush on top except as otherwise specified or indicated.

3.7 PROTECTION

A. Underground Copper Piping: Paint all uninsulated copper piping underground with two coats of asphaltic paint. Manual wiping is not acceptable.

B. Ferrous Pipe: Wrap all ferrous pipe with a layer of 6 mil polyethylene film or 15 lb. felt.

C. Pipe Embedded in Concrete: Spirally wrap all pipe lines embedded in concrete with two layers of 30 lb. felt.

D. Pipe Thread: Coat all exposed threads on galvanized steel pipe after assembly with two coats of zinc chromate. Remove pipe thread lubricants prior to applying paint.

E. Underground Metal Piping and Equipment: Cathodic protection shall be provided by furnishing and installing insulating couplings, protective coatings, sand envelopes, and sacrificial anodes. After underground piping systems with protective covering have been installed, test for electrical insulation. Make necessary modifications and corrections to any system not electrically isolated. Provide packaged anodes complete with test stations thermoweld connected to the buried materials and equipment to be protected. The location, weight and material of the anodes shall be as indicated on the drawings and installed acceptable to the Designer/OAR.

3.8 FLUSHING AND CLEANING

A. Preparation for Testing: Before final testing, flush piping systems with clean water to remove debris. Disconnect all coils and heat exchangers from the system before flushing. Flush all coils and heat exchangers separately to assure that debris does not become lodged in them. Provide temporary valves and drains as required to accomplish flushing. Minimum water velocity is 2 ft. per second for a period of one hour.

B. Final Flushing: After flushing, thoroughly clean each piping system with appropriate cleanser to remove oil, grease, lacquer, etc. Thoroughly flush each liquid system with clean water.

c. Sterilization of Potable Water Systems: After the final testing for leaks, all new potable water lines shall be thoroughly flushed to remove foreign material. Before placing the systems in service, sterilize the new water lines in accordance with Section 22 05 00.

3.9 PRESSURE TESTING

A. Pressure Test: Prior to insulating and concealing the piping system, apply a water pressure test to all parts of each system before equipment is connected. Use a hydrostatic pressure of not less than 100 psig or 150 percent of system operating pressure whichever is greater. Test system for a period not less than four hours. There shall be no leaks at any point in the system at this pressure.

B. Concealed Work: Leave concealed work uncovered until required tests have been completed, but if necessary, make tests on portions of the work and those portions of the work may be concealed after being inspected and found free of leaks. Make repairs to defects that are discovered as a result of inspections or tests with new materials; caulking of screwed joints, cracks or holes will not be accepted. Repeat tests after defects have been eliminated.

C. Field Testing: Complete all field testing prior to insulating, wrapping or backfilling.

END OF SECTION 23 21 13

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SECTION 23 23 00 - REFRIGERATION PIPING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Basic Requirements: Provisions of Section 23 05 01, BASIC MECHANICAL REQUIREMENTS are a part of this Section.

1.2 SUMMARY

A. General: Provide refrigerant piping systems, complete in all respects, between the system components and connected equipment.

1.3 SUBMITTALS

A. General: Include the following data:

1. Manufacturers Literature:

- a)** Dimensional outline drawing showing the location of all equipment piping and electrical connections.
- b)** Complete list of piping materials to be used in this section including valves, specialties, pipe material, pipe insulation, pipe sizes and method of connection for each refrigeration piping system.

2. Installation Instructions:

- a)** Manufacturer's printed installation instructions for refrigeration piping equipment including copies shipped with the equipment.
- b)** Layout of refrigerant piping with reference elevations, pipe sizes, refrigerant velocity and pressure drops between various equipment connections.

1.4 APPLICABLE STANDARDS

A. General: All equipment, material, accessories, methods of construction and reinforcement, finish quality, workmanship and installation shall be in compliance Section 23 05 01.

B. ANSI: All materials and installation shall conform to ANSI B31.5, Code for Refrigerant piping, ANSI/ASHRAE Standard 15, "Safety Code for Mechanical Refrigeration", ASME/ANSI B31.5-1987 (Refrigeration Piping), and ANSI/SAE J513, Refrigerant Tube Fittings.

C. ASME: Provide safety relief valves in conformance with ASME Boiler and Pressure Vessel Code, Section VIII Division I.

PART 2 - RODUCTS

2.1 GENERAL

A. Application: The refrigeration piping system shall be of the material indicated. See Section 23 21 13, PIPE AND FITTINGS for material specifications.

B. Pipe: Refrigerant system piping shall be refrigerant grade, dehydrated and sealed, seamless, uniformly dead soft anneal to 1-3/8 inch O.D. or hard temper annealed, type K copper tubing conforming to ASTM B280.

C. Fittings: Refrigerant grade, wrought copper, long radius, brazed joint type.

D. Brazing: Silver brazing alloy and non-corrosive flux, designed for silver brazing.

2.2 CHARGING VALVES

A. Quick Couplers: Schrader type designed for use with quick coupler hose fittings and provided with individual cap.

2.3 SPECIALTIES

A. Removable Core Filter-Drier: Provide a removable core filter-drier in liquid line with a full size valved bypass. Provide shut-off valves to isolate the filter drier.

B. Sight Glass: Provide a moisture indicating sight glass in the liquid line downstream from the filter-drier. Install the sight glass in vertical line if possible and a sufficient distance downstream from any valve to eliminate visual disturbance in the glass.

PART 3 - EXECUTION

3.1 GENERAL

A. Pipe Size: Refrigerant pipe sizes indicated are nominal. Provide sizes not less than sizes indicated and in compliance with manufacturer's recommendations. Provide change in sizes in accordance with manufacturer's recommendation and Designer's acceptance. Piping shall maintain a minimum velocity of 500 fpm in horizontal lines and 1000 fpm in vertical risers for proper oil return. Provide double suction risers with oil trap or accumulator and hot gas risers as may be necessary.

B. Flexible Connection: Provide flexible piping in suction and hot gas discharge line of compressor. Flexible piping shall be a 15 pipe diameter loop or similar measure to prevent transmission of vibration.

C. Specialties: Refrigerant valves, driers, expansion valves, and similar items shall be provided with each system. Refrigerant charging valves not furnished by the manufacturer shall be field installed to enable charging and checking the system.

3.2 JOINTS AND CONNECTIONS

A. General: All joints and connections shall be permanently refrigerant tight. Arrange piping generally as shown allowing for service access. Refrigerant lines shall be run as direct as possible with a minimum number of joints. Provide sleeves through floors, walls or ceilings, sized to permit installation of full-thickness insulation. Sleeves shall be sealed air tight after installation of piping and insulation.

B. Brazed Joints: Refer to Section 23 21 13, PIPE AND FITTINGS. All joints shall be brazed unless otherwise indicated.

C. Scale Prevention: Keep pipe system full of inert gas to prevent scale formation while brazing.

D. Hangers and supports: Refer Section 23 05 03. Isolate copper tubing from contact with dissimilar metals.

3.3 EVACUATION AND CHARGING

A. General: Non-factory charged equipment and piping systems shall be evacuated and charged as follows: Charge the system with dry nitrogen to a minimum of 1-1/2 times the working pressure, but not less than 30 psig and leak test all joints including factory piping within the units. Repair all leaks by disassembling and remaking the joint. After all leaks are corrected, evacuate the system to an absolute pressure of 0.2 inches of mercury. System shall hold this vacuum for 4 hours with no noticeable rise in pressure. After the vacuum test, break vacuum twice, flushing with dry nitrogen each time and re-evacuate for a minimum of 2 hours each time. Charge the system in accordance with the manufacturers recommendation and accepted refrigeration practice.

3.4 REFRIGERANT PIPING CONDUIT

A. General: Refrigerant piping below slab or grade shall be installed in Schedule 40 PVC piping. Size conduit to properly install piping. Provide long bend sweeps. Conduit shall drain and not trap water. Protect ends of conduit from entry of vermin, insects and water.

3.5 OTHER REQUIREMENTS

A. Charging Connection: Provide a refrigerant charging connection in the liquid line upstream from the filter-drier.

B. Installation: Keep piping free from traps unless otherwise indicated. Install vertical pipe plumb. Pitch horizontal piping only where slope is desirable to prevent liquid refrigerant or oil from traveling toward the compressor inlet.

C. Valve Locations: Provide shut-off valves at inlet and outlet to all condensers, receivers and evaporators to permit isolation for service. Use angle valves to minimize pressure drop. Use globe valves only when angle valves are impractical. Valves in copper tubing 7/8 inch or smaller shall be mounted independent of tubing supports or fastenings.

D. Solenoid Valves: Provide solenoid valves in upright position in horizontal lines, unless their design allows installation in vertical pipe.

E. Piping Loop: Where compressor does not have pump down control and the evaporator coil does not have bottom suction header connections and is located above the compressor, then loop the suction line to top level of coil to prevent liquid slugging.

F. Expansion Valve Operation: To prevent erratic operation of thermal expansion valve, provide a suction line trap next to evaporator coil suction outlet with a pilot thermostatic expansion valve, a pilot-operated main expansion valve, and expansion valve bulb located between coil and trap. Provide only in suction lines which are level leaving coil outlet or which rise on leaving coil outlet. Trap is not required when evaporator coil outlet suction line drops to compressor or suction header immediately after expansion valve bulb.

G. Insulation: Insulate refrigerant suction line with 3/4 inch elastomeric preformed pipe insulation, unless otherwise noted, in accordance with Section 23 07 00, THERMAL INSULATION.

END OF SECTION 23 23 00

SECTION 23 31 00 - DUCTWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Basic Requirements: Provisions of Section 23 05 01, BASIC MECHANICAL REQUIREMENTS are a part of this Section.

1.2 SUMMARY

A. General: Provide complete duct systems as indicated.

1.3 SUBMITTALS

A. General: Include the following data:

1. Manufacturers Literature:

- a)** Complete set of published data on factory prefabricated duct construction material including sheet metal gauges, with indication of each material, method of construction, support method, and its intended application and design pressure limitation.
- b)** Complete set of published data on duct sealant, mastic, and gasket material to be used, including its intended application.

2. Performance Data: Operating pressure for each duct system.

3. Installation Instructions:

- a)** Manufacturer's printed instructions for the installation of prefabricated ductwork including copies shipped with the material.
- b)** Manufacturer's printed instructions for the installation of the internal acoustical liner.

B. Shop Drawings:

1. Refer to Section 23 05 01. Provide detailed shop drawings for the following systems:

- a)** All duct systems.
- b)** Supply and return systems.
- c)** All exhaust systems.

1.4 TERMINOLOGY

A. Dimensions: All ductwork dimensions are nominal free clearance internal dimensions which do not include insulation thickness, unless otherwise indicated.

B. Finish: Where ductwork is exposed to view in occupied spaces, provide materials free from visual imperfections including pitting, seam marks, stains and discolorations, and other defects including those which would impair painting. Sheet metal in exposed locations shall be mill-phosphatized unless otherwise indicated.

1.5 APPLICABLE STANDARDS

A. SMACNA: Use material, weight, thickness, gauge, reinforcing, seams and joints, suspension, workmanship and construction and installation methods as outlined in the Sheet Metal and Air Conditioning Contractors National Association, Inc., HVAC Duct Construction Standards, Metal & Flexible. Manufactured round or oval ductwork shall comply with the manufacturer's published recommendations and installation instructions. Where duct gauge and reinforcement is specified for rectangular ducts, the following nominal metal thicknesses shall be used:

TABLE - METAL THICKNESS - DECIMAL INCHES

Metal Gauge	26	24	22	20	18	16	14	12
Galvanized	.0217	.0276	.0336	.0396	.0516	.0635	.0785	.1084

B. HVAC Duct Leakage Standard: Duct leakage test methods, apparatus, and reporting shall comply with the requirements of the SMACNA HVAC Air Duct Leakage Test Manual and as otherwise indicated.

C. NFPA: The duct system, fittings, sealants and accessories shall comply to NFPA 90A requiring a flame spread rating of not over 25 and a smoke developed/fuel contributed rating no higher than 50.

d. Underwriters' Laboratories Rating: All flexible fiberglass duct shall be listed Class 1 by the UL-181 standards rating.

e. AWS: All welded duct shall comply to American Welding Society AWS D9.

f. ASTM: Unless otherwise specified, American Society for Testing and Materials specifications applicable are:

Material	Type	ASTM Number
Galvanized Steel	----	A525
Stainless Steel	302, 304	A480
Cold Rolled Steel	----	A366
Aluminum	3003 H-14	B209

PART 2 - PRODUCTS

2.1 MANUFACTURER:

- A. General: Refer to Section 23 05 01.

2.2 GENERAL

- A. Special Gauges and Construction:

1. Gauges: Gauges indicated in this section are for galvanized steel. Where gauges are indicated for a material other than galvanized steel, provide the indicated gauge.
2. Flat Oval Duct: Shall be used only on positive pressure systems.

2.3 SHEET METAL DUCTWORK

A. Material: Prime quality 48 inch wide re-square tight coat cold-rolled hot-dipped galvanized steel capable of double seaming without fracture. Conform to the requirements of ASTM A-525 and ASTM-G90 for a minimum galvanizing coat of 1.25 ounces per square foot total for both sides.

B. Square and Rectangular Duct Connections: Manufactured air duct connections with gasket tape, integral mastic sealer and bolted connections maybe used for transverse joints.

1. Manufacturer:

- a) Ductmate Industries, Inc.
- b) Approved substitution

C. Round and Oval Ducts: Manufactured round and oval ducts may be used provided they comply with the manufacture's published standards.

1. Manufacturer:

- a) United-McGill
- b) Semco
- c) Approved substitution

2.4 FLEXIBLE DUCTS

A. Insulated flexible ducts, Fiberglass: Flexible duct shall be factory-fabricated pre-insulated type with seamless vapor barrier. Fiberglass insulation shall be nominal 1 inch thickness with maximum thermal conductance of 0.23 BTU/hr-sq.ft.-degree F. at 75 degree F. mean temperature. Flexible duct shall have an operating pressure range of minus 0.5 inch w.g. to plus 2 inch w.g., maximum working velocity to 4000 fpm and temperature range to 250 degree F. Core shall be continuous and consist of aluminized mylar laminated to a corrosion resistant steel wire helix. Vapor retardant rating shall be 0.17 perm maximum per ASTM E96-A.

1. Manufacturer:

- a) Thermoflex

- b) ATCO
- c) Approved substitution

B. Insulated flexible ducts, solid inner wall: Flexible ducts with solid inner wall shall be pre-insulated with a minimum of one inch thick, one pound density fiberglass. The fiberglass shall be protected by a non-combustible minimum 2.5 mil thick polyethylene vapor barrier. The inner wall shall be single-ply aluminum with interlocked seams to provide an airtight and impervious layer between the fiberglass insulation and the moving airstream. The solid inner wall flexible duct shall be tested in accordance with the requirements of UL Standard 181 and shall be UL listed as a Class I flexible air duct connector, the operating range shall be up to 200 degrees F., and a working pressure of 10 inches of positive or negative static pressure.

1. Manufacturer:

- a) Clevaflex
- b) Approved substitution

2.5 MISCELLANEOUS

a. Support materials: Angles and other structural shapes used in connection with galvanized steel sheets shall be zinc-coated steel. Hanger rods shall be minimum 3/8 inch diameter, hot-rolled mild steel. Rivets, screws, and other accessories shall be made of the same materials as the duct or casing. Minimum screw size shall be No. 8 and minimum rivet diameter shall be 5/32 inch.

b. Sealant/Mastic: Low-odor, oil-resistant, non-hardening migrating mastic or liquid neoprene-based cement, applicable for fabrication or installation, shall be used as compounded specifically for sealing fitting components or longitudinal seams in ductwork. Oil- or asphalt-based caulking compounds are not acceptable.

1. Manufacturer:

- a) Childers
- b) H. B. Fuller/Foster
- c) United McGill
- d) 3M

c. Gaskets: Gasket material shall be soft elastomer butyl or neoprene rubber formed for the specific application.

PART 3 - EXECUTION

3.1 GENERAL

A. Criteria: All duct systems shall be furnished and installed free of noise, chatter, vibration, breathing and pulsation under all conditions of operation. Remove, replace or reinforce to correct adverse conditions. Fiberglass duct is not allowed on the project.

B. Field Conditions: If field conditions are determined to exist which would limit the guarantee of air delivery or system performance, submit notice in writing to the Designer. Prior to ductwork fabrication, verify dimensions at the site, making field measurements and drawings necessary for fabrication and erection. Take precautions to avoid space interferences with beams, columns, joists, pipes, lights, conduit, other ducts, equipment, etc. Make necessary revisions to routing where any spatial or coordination conflicts appear, at no additional cost to the Owner or change in the contract price.

C. Preparation for Installation: Ductwork shall be shop-fabricated in lengths sufficient to minimize the number of joints, and shall be preassembled in the shop to the greatest extent possible to minimize field-assembly of the system. Space duct joints to avoid cutting when installing branch takeoffs, outlet collars, etc. Disassemble ductwork only to the extent necessary for shipping and handling; match-mark sections for re-assembly and coordinated installation. Install concrete inserts for support of the ductwork in coordination with the formwork to avoid delays.

D. Installation: Properly support and align ductwork accurately at connections within 1/8 inch misalignment tolerance. Ducts shall be free of sags and bulges. Hang ductwork below concrete floors or roof deck with hangers set prior to pouring concrete, or from self drilling screw anchors. Gun powder set anchors are not permitted. Locate duct runs, except as otherwise indicated, vertically and horizontally, avoiding diagonal runs wherever possible. Parallel runs of horizontal ducts shall be grouped together on trapeze or strap hangers. Hold ducts as close to the structure above as possible. Maintain a minimum 6 inch clearance between walls and duct or duct exterior insulation for inspection.

E. Duct Cleaning: Continuously cap open ends of ductwork to prevent entry of dust, debris and foreign material throughout the installation. Where the interior of ductwork has been exposed to dust or debris, clean the interior of the entire ductwork system from the point of debris entry to the duct termination.

F. Duct Penetrations: Where it is necessary that ducts be divided due to pipes or other obstructions which must pass through these ducts, provide air-stream deflectors in the duct and increase the duct size to maintain equivalent area around the deflectors. Such changes shall be in accordance with standard SMACNA details and shall be shown on As-Built Drawings.

G. Interior Duct Painting: Interior of ductwork visible through registers, grilles, or diffusers shall be painted flat black.

H. Prohibited Duct Locations: Do not route ductwork through transformer vaults, or into electrical rooms or elevator equipment spaces unless the ductwork is dedicated to serving that space. Do not install ductwork over elevator equipment, electrical distribution panels or motor control stations.

I. Balancing Devices: Due to clarity of the drawings, not all duct balancing dampers may be indicated. However, provide each duct branch and each duct takeoff with a balancing damper to assure correct balance and quiet distribution of indicated air quantities.

J. Equipment Connections: Provide and install all duct connections to air handling units and fans and provide flexible connections, elbows and bends which minimize noise and pressure drop. Provide and install all necessary blank-off safing plates or transitions required to facilitate installation. Provide flexible connections between ductwork and all rotating or vibrating equipment.

K. Coordination: Coordinate dimensions at interfaces of dissimilar type of ductwork and at interfaces of ductwork with equipment so that proper overlaps, interfaces, etc., of insulation and continuity of vapor barriers are maintained. Where ducts of two dissimilar metals meet, the joints shall be installed such that the metals do not contact each other.

I. Exterior Insulated Duct: Provide a seamless insulation finish around damper operating quadrants, splitter adjusting clamps, access doors, and similar operating devices with a metal collar equivalent in depth to insulation thickness and suitably sized to which insulation may be finished.

3.2 SHEET METAL DUCTS

A. Construction: Provide corner closures. Longitudinal seams and transverse joints shall be flat and smooth inside. Make slip joints in direction of air flow. Longitudinal joints shall be Pittsburgh lock or double corner seam. Button punch snaplock construction is not acceptable. All welds shall be continuous and corrosion-resistant. Sealant shall be applied over the continuous length of every seam.

B. Fittings: Fabricate offsets, turns and elbows with centerline radius equal to 1-1/2 times diameter when possible. No mitered offsets will be allowed.

C. Round/Oval: Use manufactured ductwork where round or flat oval is indicated. Where round or oval low pressure ductwork is designated to have internal acoustical/thermal liner, provide factory-fabricated double-wall ductwork.

d. Vapor Retardant: Where exterior-insulated ductwork connects to ductwork without exterior insulation, the exterior insulation shall overlap the connecting duct a minimum of 4 inches. The vapor retardant on the exterior insulation shall be sealed to the exposed metal duct.

3.3 FLEXIBLE DUCTS

A. Installation:

- 1.** Flexible duct shall be a maximum of 6 feet in length on inlets to diffusers, unless otherwise indicated and shall be fully extended to smooth out internal corrugations, and shall be installed without kinks, compression or obstructions so that pressure drop is minimized. Install with a maximum equivalent of two 90 degree bends. No bend shall be made with centerline radius of less than four and one-half diameters for metal ductwork. No additional flexible duct shall be provided for future relocation unless otherwise indicated; cut and remove excess length.
- 2.** Flexible duct shall be supported at ends and at each 90 degree bend. Maximum permissible sag is 1/2 inch per foot of spacing between supports.
- 3.** Hanger and saddle material in contact with the flexible duct shall be of sufficient width to prevent any restriction of the internal diameter of the duct when the weight of the supported section rests on the hanger or saddle material. In no case will the material contacting the flexible duct be less than 1 inch wide. Hanger shall be used in conjunction with a sheet metal saddle formed to cover one-half the circumference of the outside diameter of the flexible duct and shall be rolled to fit neatly around the lower half of the duct's outer circumference.

4. Factory installed suspension systems integral to the flexible duct are an acceptable alternative hanging method when manufacturers recommended procedures are followed.
5. To prevent tearing of vapor retardant on fiberglass duct, do not support entire weight of flexible duct on any one hanger during installation. Avoid contact of flexible duct with sharp edges of hanger material. Damage to vapor retardant may be repaired with vapor sealant tape. If internal core is penetrated, replace flexible duct.
6. Connect flexible ductwork to collars on rigid ductwork with locking clamps and adhesive.
7. Terminal devices connected to flexible duct shall be supported independently of the flexible duct.

3.4 SUPPLY, RETURN, INTAKE, EXHAUST AND RELIEF DUCTWORK

A. General Air Moving Systems: Ductwork shall be constructed of galvanized sheet metal unless otherwise indicated and shall comply with SMACNA Pressure Classification.

B. Minimum Requirements: Unless otherwise indicated all ductwork shall comply with the following minimum pressure requirements:

1. 2 inch w.g. Pressure:
 - a) From the return air inlet device to the inlet of the return fan or air handling fan return connection.
 - b) From the supply fan discharge to supply registers (Single Zone System).
2. 1 inch w.g. Pressure:
 - a) From the room exhaust device to the inlet of the roof exhaust fan.
3. All supply, return and outside air ducts shall be externally insulated unless specifically indicated to be internally insulated, extending from supply fan discharge, throughout system, to all outlets. Unless otherwise indicated, external insulation shall be a minimum 2 inch thick fiberglass duct wrap where concealed and 1-1/2 inch thick duct board, where exposed; finish as specified.

C. Toilet exhaust, general exhaust: Ductwork shall not have internal insulation, and does not have to be externally insulated unless otherwise indicated.

3.5 CHANGES IN SHAPE OR DIMENSION

A. Criteria: Where duct size or shape is altered to effect a change in area, the following shall apply:

1. Do not exceed a slope of 1 inch in 7 inches for transitions with increasing area.
2. Do not exceed a slope of 1 inch in 4 inches for transitions with decreasing area; 1 inch in 7 inches is preferable and should be used wherever possible.
3. Transition angles shall not exceed 30 degrees at inlet connections to coils or other equipment, nor 15 degrees at outlet connections.

3.6 MATERIALS AND APPLICATIONS FOR SEALING DUCTS

- a.** Liquid Sealant: Use only for slip type joints where sealant is to fill space between overlapping pieces of metal. Do not use where metal clearances exceed 1/16 inch.
- b.** Mastics: Use in lieu of liquid sealant as a filler, in grooves and between flanges.
- c.** Tape: Tape is not allowed to seal sheet metal ducts.
- d.** Combination of mastic and embedded fabric: Use mastic/mesh/mastic layers as a sealant where pressure equals or exceeds 3 inch w.g. and where any space between metal surfaces at transverse joints, longitudinal seams or duct wall penetrations exceeds 1/16 inch.
- e.** Surface preparation: Surfaces to receive sealant should be free from oil, dust, dirt, rust, moisture, ice crystals and other substances that inhibit or prevent bonding. Use solvent and apply a face primer if necessary to obtain a clean surface for adhesion.
- f.** System Preparation: Remove all dirt and foreign material from the entire duct system and clean diffusers, registers and grilles before operating fans.

3.7 DUCT ACCESS DOORS

- A.** General: All supply and return ductwork including outdoor air intakes shall be provided with access doors to access fire dampers, smoke dampers, or other duct mounted equipment. Refer to Section 23 33 00.
- B.** Location: Duct access doors shall be located such that they may be accessed by a person standing on a ladder. Access doors located above a ceiling shall not be more than 42 inches above the ceiling unless a work platform is provided. The access doors may be located on the sides or bottom of the ductwork.
- C.** Size: Refer to Section 23 33 00.

END OF SECTION 23 31 00

SECTION 23 33 00 - DUCTWORK SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Basic Requirements: Provisions of Section 23 05 01, BASIC MECHANICAL REQUIREMENTS are a part of this Section.

1.2 SUMMARY

A. General: Provide necessary duct system accessories to assure balanced, quiet and draftless distribution and conveyance, with minimum of turbulence, noise and pressure drop for supply, return, exhaust and ventilation systems indicated.

1.3 SUBMITTALS

A. General: Include the following data:

1. Manufacturers Literature:

a) Dimensional outline drawing of the following products:

- 1)** Flexible duct connection.
- 2)** Splitter damper.
- 3)** Turning vanes.
- 4)** Air extractors.
- 5)** Manual volume dampers.
- 6)** Backdraft dampers.
- 7)** Fire dampers.
- 8)** Roof mounted air outlets and inlets

2. Installation Instructions:

a) Manufacturer's printed installation instructions for each of the products listed including copies shipped with the equipment.

1.4 APPLICABLE STANDARDS

A. General: All equipment, material, accessories, methods of construction and reinforcement, finish quality, workmanship and installation shall be in compliance with the applicable standards and codes listed in Section 23 05 01.

B. SMACNA: Use material, weight, thickness, gauge, reinforcement, seams and joints, suspension, workmanship, construction and installation methods as outlined in the Sheet Metal and Air Conditioning Contractors National Association, Inc. HVAC Duct Construction Standards, Metal & Flexible, or in accordance with the manufacturer's recommendations.

C. NFPA: The duct fittings, accessories and sealants shall comply to the requirements with NFPA 90A, requiring a flame spread rating of not over 25 and a smoke developed/fuel contributed rating no higher than 50.

D. AWS: All welding of fittings and accessories to ductwork shall conform to American Welding Society AWS D9.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. General: Refer to Section 23 05 01. Model numbers or product type listed for manufacturers are given to provide an example of the item required.

2.2 GENERAL

A. Clear Dimensions: Ductwork dimensions indicated which may affect items of this section are nominal free clearance internal dimensions, not including interior insulation thickness, if any.

B. Gauges: Gauges indicated in this section are for galvanized steel. Where gauges are specifically indicated for a sheet metal material other than galvanized steel, provide the indicated gauge.

2.3 FLEXIBLE DUCT EQUIPMENT CONNECTION

A. Flexible Duct Connections: Duct Connector shall be a waterproof neoprene-coated polymer fabric specifically manufactured to provide an airtight flexible connection between ductwork and rotating or vibrating equipment. Minimum tear and tensile strength shall be 125 and 300 pounds respectively.

1. Manufacturer:

- a)** Ductmate Proflex Vinyl
- b)** Durodyne
- c)** Ventfabrics
- d)** Or Approved Equal

2.4 SPLITTERS

A. General: Provide splitters for adjustment of air volume to the respective branches where indicated, constructed of the same material and at least the same gauge as the duct, but not less than twenty-two gauge. Use in duct systems to 2 inches w.g. only. Splitters shall be rigidly attached to pivot rod and operating linkage; install on raised insulated base when used in internally insulated ductwork. Splitter blades shall be formed in two thicknesses of metal with a rounded edge to air flow.

B. Manufacturers:

1. Ventlock
2. Ruskin
3. Metalaire
4. Or Approved Equal

2.5 TURNING VANES

A. General: Turning vanes shall be completely flutter-proof; permanently fixed type aluminum, steel with acid/solvent chemical corrosion resistant coating, or galvanized steel. Turning vanes shall be minimum 24 gauge for single thickness and 26 gauge for double thickness and airfoil vanes. Turning vanes shall be securely fastened to a runner; vane edges shall project airflow parallel to duct sides. Airfoil-type turning vanes shall be constructed of galvanized steel or aluminum with a sound-attenuating fiberglass inner liner and open protective metal facing.

B. Manufacturer and Type:

1. Barber-Coleman, Airturns
2. Dura-Dyne, VR
3. Hart & Cooley
4. Or Approved Equal

2.6 EXTRACTORS

A. General: Extractors shall deflect, proportion and direct the indicated air quantities to the branch duct and to the registers, grilles or other outlets without causing objectionable noise or pressure drop.

B. Adjustable Multi-vaned: Multi-vaned with vanes on 1 inch centers where required to have shutoff capability or unless otherwise indicated; adjustable gang-operated and synchronized to remain parallel to flow regardless of extractor angle.

1. Minimum .040 thick aluminum, steel with acid/solvent chemical corrosion resistant coating or galvanized steel

C. Actuator: Provided with manual actuator devices for adjusting and securing the position of these deflectors; these devices shall allow adjustment of the deflectors from outside the ductwork without puncturing or penetrating ductwork or its vapor barrier. Provide remote actuator assembly where required.

D. Manufacturer and Type:

1. Titus, Model AG-45 or AG-225 Volume Extractor
2. Waterloo, Type DTM or DT2M Extractor
3. Anemostat, DTB or DTA
4. Young Regulator, 890 or 890A
5. Or Approved Equal

2.7 MANUAL VOLUME DAMPERS

A. General: These dampers are other than those specified as being integral with a register, diffuser or other air outlet or inlet.

B. Criteria: Volume dampers shall meet the following criteria:

1. For ducts up to 100 square inches in area, use single blade dampers of minimum 20 gauge.
2. Opposed blade type multi-blade dampers shall be a minimum 4 inch deep and fabricated of minimum 16 gauge galvanized steel blades with a welded 16 gauge galvanized steel channel frame; sheet metal screws shall not be used in the construction of any damper. Blades shall ride in bronze bushings on 3/8 inch steel shafts suitable for motor operation. Damper blades shall be operated by a common linkage, with a 6 inch maximum blade width, and shall be formed with double 90 degree bends to ensure positive air lock and maximum strength. Blades shall be felt-tipped to ensure tight closure and noiseless operation, and shall be capable of opening to a full 90 degrees; damper linkage shall incorporate a positive 90 degree opening stop.
3. Dampers shall be made of galvanized steel, stainless steel, steel with acid/solvent chemical resistant coating, or steel sprayed or dipped aluminum rust resistant finish as required to match the attached duct material; stiffened and fabricated to prevent vibration and flutter.
4. Damper adjustment shall be from outside the completed ductwork without puncturing or otherwise penetrating the ductwork or its vapor retardant.
5. Dampers shall be fully adjustable and with locking device and damper position indicator. The damper and damper frame may be fabricated in one section to 48 inch in width and 90 inch in height; larger sizes shall be made in sections with mullions.
6. Pressure drop through the damper shall not exceed 0.03 inches w.g. at 1000 fpm velocity based on the damper face area. The damper shall have full shutoff capability, with leakage rates less than 10 cfm/square ft of damper face area at 4 inches w.g. Airfoil opposed blade dampers shall be provided if the velocity through a fully opened damper exceeds the manufacturer's printed maximum velocity limit.
7. Manufacturer:
 - a) Air Balance, Inc.
 - b) Greenheck
 - c) Louvers and Dampers
 - d) Penn
 - e) Ruskin
 - f) Young Regulator Co.

2.8 BACKDRAFT DAMPERS

A. General: Backdraft dampers shall be the multi-blade, weighted type with counter-balanced blades. Damper frame shall be aluminum or galvanized steel suitable for flange and gasket connection to ductwork. Blade edges shall have vinyl or polyurethane foam gasketing with ball bearings.

B. Manufacturer:

1. Air Balance
2. Louvers & Dampers
3. Ruskin
4. Or Approved Equal

2.9 DUCT ACCESS DOORS

A. General:

1. Doors shall be factory prefabricated double wall, 24 gauge galvanized steel. Access doors shall be able to withstand the same test pressures without deformation, vibration or leakage as the ductwork and casings in which they are installed.
2. Access door minimum size shall be as large as is compatible with the duct size but in no case less than the following (provide larger sizes if necessary to permit proper access operation):

Maximum Duct Dimensions	Access Door Size
11" and less	10" x 12"
12" through 16"	12" x 16"
17" and over	16" x 24"

B. Latches: Doors shall be provided with adjustable tension catches and shall be gasketed around their perimeters with felt or soft rubber gasketing attached to the doors with cement and countersunk rivets for an airtight seal. Access doors less than 24 inch in height shall have a continuous piano hinge (or two 1 inch by 1 inch butt hinges where concealed) and one panel latch; access doors in casings and ducts 24 inch in height and over shall have two heavy butt hinges and two pairs of lever-type latches operable from both sides of the door, installed to open against air pressure. Access doors shall be fastened with spring clips which release in the event of sudden negative pressure, such as created when a damper closes, to prevent duct implosion.

C. Indicators: Where access doors are concealed in hung ceiling, provide indicator buttons in the ceiling immediately below the access door.

d. Insulated: Insulated access doors shall have a minimum 1 inch rigid 6-pound density fiberglass board between the inner and outer panels.

e. Manufacturer:

1. Ventfabrics, Inc., Ventlok
2. Ruskin
3. United Sheet Metal
4. Or Approved Equal

2.10 FIRE AND COMBINATION FIRE/SMOKE DAMPERS

A. General:

1. Fire and combination fire/smoke dampers shall comply with Underwriters Laboratories (UL) Standard 555 and bear the UL test label with a 1-1/2 hour fire protection rating for penetrations in 1 hour and 2 hour rated partitions, and a 3 hour fire protection rating for penetrations in 3 hour rated partitions. Dampers shall be tested under dynamic load. Smoke control dampers, combination fire/smoke dampers and their operators shall comply with UL Standard 555S, and be listed for airflow in either direction to permit use in an engineered smoke evacuation system and to permit installation with the actuator outside the chases.
2. Dampers shall be selected so that the free air space is not less than the connected duct free area.

B. Manufacturer:

1. Prefco
2. Ruskin Mfg. Co.
3. Greenheck
4. Nailor Industries
5. Penn

C. Fire Dampers: The damper casing shall be 11 gauge galvanized steel with bonded red acrylic enamel finish. Interlocking damper blade assembly shall be unaffected by corrosion or high heat. Unless otherwise indicated, damper blade assembly shall be curtain-type located out of the airstream; where multi-blade dampers are used (typically only at grilles and registers) they shall be spring-driven airfoil blades with a maximum pressure drop of 0.1 inch w.g. at 2500 fpm air velocity. Mechanical parts shall have bronze non-corrosive pins. Fire dampers shall close automatically and remain tightly closed by a catch mechanism upon the operation a fusible link rated at approximately 160-165 degree F. Where indicated on the drawings, linkages shall be rated to 286°F. Provide factory furnished duct installation sleeve of minimum 16 gauge for dampers up to 36 inch wide x 24 inch high and 14 gauge for larger sizes.

D. Combination Fire/Smoke Dampers: Dampers shall comply with the requirements for fire dampers listed above. Damper actuator shall be spring-return fail-safe, linked to the damper for normally-closed operation upon loss of control signal, and able to close the damper at pressures encountered in normal operation, including airstream loading effects on the blades. Damper blade assembly shall be airfoil type with a maximum pressure drop of 0.1 inch w.g. at 2500 fpm air velocity. Damper air leakage rate shall not exceed the requirements of Class I with a maximum of 4

cfm per square foot at 1 inch w.g. pressure. Damper actuator shall be mounted out of the air stream, and actuator and mounting bracket shall not extend beyond the height of the damper frame. Provide damper with fusible link set to initiate closing at 165 degree F. duct temperature. Damper actuator shall be able to be remotely closed and remotely reset. Damper actuator shall be operated by 24 volt ac.

2.11 ROOF MOUNTED AIR OUTLETS AND INLETS

A. Construction: Heavy gauge aluminum construction, hinged hood, all seams continuously welded, hoods sloped for interior condensate drainage and exterior weather drainage, aluminum wire mesh bird and bug screen.

B. Accessories

1. Roof Curb: Aluminum construction, self flashing, insulated, 18" unit height.
2. Gravity Backdraft Damper: Parallel blade, aluminum or galvanized construction, adjustable closing force.

c. Manufacturer:

1. Greenheck, Inc.
2. Loren Cook
3. Ruskin

PART 3 - EXECUTION

3.1 GENERAL

A. Transitions: Provide and install transitions where required for final connection to any duct fitting, accessory, device or duct-mounted equipment.

b. Location and Use of Dampers: Install a volume damper at each duct branch, as far as possible upstream from air inlets or outlets, to attenuate noise transmission caused by damper throttling. Where the necessary pressure drop across a single volume damper becomes excessive and cannot be reduced through the use of splitter dampers or extractors and creates objectional noise in the opinion of the Designer, an orifice plate shall be installed. The orifice plate shall be sized to provide sufficient pressure drop to allow the volume damper to control the air flow without any objectional noise transmission. Use splitter dampers, extractors or orifice plates only where manual volume dampers will not accomplish the intended balancing, or where indicated. The use of splitter dampers, extractors or orifice plates shall not eliminate the need for specified or required manual dampers.

c. Duct Mounted Smoke Detectors: Install duct mounted smoke detectors where indicated in strict accordance with manufacturer's recommendations.

3.2 TURNING VANES

A. General: Install turning vanes for all short-radius elbows where the centerline radius is less than 1-1/2 times the duct width, and all square corner bends with a transition angle greater than 30 degrees. Install vanes in sections or use tie rods to limit the unbraced vane length. Turning vanes

shall be single-wall type for ducts with a vane runner length less than 18 inch and air velocity less than 2500 fpm; duct systems with longer runner lengths or higher air velocities shall use double-wall vanes. Airfoil-type vanes shall be used wherever the duct static pressure exceeds 2 inches w.g. If the duct size changes in a mitred elbow, the vanes shall be fitted with a trailing edge extension.

3.3 DUCT ACCESS DOORS

A. General: Provide and install an access door in the ductwork for each fire, smoke, fire/smoke and motorized damper; in-line duct heater and coil; permanent test ports; and where access for observation or maintenance is necessary.

3.4 FLEXIBLE DUCT EQUIPMENT CONNECTIONS

A. General: Provide flexible duct connections where air handlers, fans and blowers connect to their ductwork. Flexible duct connections shall be installed as follows:

1. Connections shall be at least 4 inches long and shall not be stretched tight or have any metal touching. The flexible material shall not be skewed.
2. Connections shall be attached on each side to metal (either metal ductwork, air handling apparatus, or heavy gauge steel sleeves).

3.5 FIRE, SMOKE AND COMBINATION FIRE/SMOKE DAMPER

A. General: Fire damper assemblies shall be sealed for air leakage prior to installation. Sealing of holes in the corners of the frame shall be done with fire retardant mastic.

B. Access: Provide access doors at each fire damper and combination fire/smoke damper, on the same side of the partition as the actuator, with door size and location which will facilitate replacing fusible links and resetting the damper. The access door shall be insulated when installed in insulated ductwork. Exterior duct insulation around the insulated access door shall be sealed to provide a continuous vapor barrier.

C. Damper Location and Type: Fire and combination fire/smoke dampers shall be installed to provide a positive barrier to the passage of air when in a closed position, and shall be installed to be self-supporting in case of duct destruction due to heat. Care must be exercised that the frame is set so that the closing devices on fire, smoke and combination dampers do not bind. All dampers shall be secured by retaining angles fastened to the sleeve in the wall or floor which they penetrate. The entire outside perimeter of the duct penetration and each angle shall be caulked with a mastic which has a flame spread rating of not exceeding 25 and a smoke developed/fuel contributed rating not exceeding 50. Smoke and combination fire/smoke dampers shall be installed with allowances for the actuator and access to the actuator.

1. Install curtain type fire dampers in ducts where indicated on drawings at locations other than grilles and registers.
2. Install multi-blade type fire damper behind registers and grilles where the stackhead penetrates a fire rated partition.

D. Fire/Smoke Damper Operation: Provide all interconnection wiring, tubing, relays, etc. to operate the fire/smoke dampers such that when each air handling unit is shut down (power to the

fan motor is disconnected) the dampers associated with that air handling unit will close; whenever the fan motor is energized the associated fire/smoke dampers will open.

3.6 DUCT ACCESS DOORS

- D.** Install in accordance with manufacturers written installation instructions.
- b.** Coordinate installation requirements with roofing sub-contractor.

3.7 TEST OPENINGS

A. General: Furnish and install capped test openings for test equipment (pitot tubes, etc.) on the entering and leaving sides of air handling units, duct-mounted coils and other airside equipment. Locate these test openings in each main supply duct at the downstream end of the straightest run of the main before the first take-off. Form test ports by drilling as many evenly-spaced 7/16 inch holes in the duct as will fit on maximum 8 inch centers, lined up perpendicular to the airflow. Holes shall be sealed with replaceable plastic plugs, and shall be made accessible through exterior insulation for future balancing.

3.8 FITTINGS AND TRANSITIONS

A. Divided Flow Fittings: All divided flow fittings shall be furnished as separate fittings; tap covers welded into spiral duct sections are not acceptable. All tees, crosses and laterals up to and including 12 inch diameter shall have a minimum 3/8 inch radius rounded entrance into the tap, produced by machining, press forming or hand-grinding smooth and free of projections, weld build-up, burrs or irregularities. All round duct tees and crosses shall be the spun conical converging type for branch entrances, with a raised bead on the throat of the fitting to assure a tight positive connection. Lateral and Y-type fittings shall be constructed so that airstream converge or diverge at angles of 45 degrees or less.

B. Construction: All welded fittings shall have continuous welds along all seams.

C. Flexible Duct Connectors: Provide spin-in type connector fitting with balancing damper at all connections between rigid sheet metal duct and flexible duct at the upstream end of the flexible duct.

D. Branch Takeoffs: Unless indicated otherwise, branch takeoff connections shall be made with 45 degree laterals or 45 degree elbows. Where 90 degree branches are shown, provide conical tees or "shoe" fittings at a 45 degree entry, with a lockable quadrant damper.

E. Elbows: Elbows shall be die-stamped or multiple-gore construction with seam circumferential joints unless shown as mitred square elbows with turning vanes, except elbows 8 inch in diameter or less shall be die-stamped. All offsets in excess of 30 degrees shall have radius fittings with a minimum 1.5 ratio; provide turning vanes in all elbows and bends as specified herein.

END OF SECTION 23 33 00

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SECTION 23 34 00 - FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Basic Requirements: Provisions of Section 23 05 01, BASIC MECHANICAL REQUIREMENTS, are a part of this Section.

1.2 SUMMARY

A. General: Provide fans as specified herein and of size, type, capacity, and electrical characteristics indicated.

1.3 SUBMITTALS

A. General: Include the following data:

1. Manufacturers Literature:

- a)** Dimensional outline drawing for each of the specified fans including operating weight
- b)** Dimensional drawing of roof curbs as applicable.

2. Performance Data:

- a)** Fan brake-horsepower for each fan at scheduled static pressure including drive losses
- b)** Actual motor horsepower, voltage and phase for each fan.
- c)** Fan curve for each fan indicating flow, static (or total) pressure developed, efficiency, and fan speed at the design point.
- d)** Fan sound power levels for each fan at operating conditions.
- e)** Vibration isolators for each fan located inside the building.

3. Installation Instructions: Manufacturer's printed instructions for the installation of each type of fan including copies shipped with the equipment.

4. Maintenance Instructions: Manufacturer's printed instructions for the maintenance of each type of fan provided.

1.4 APPLICABLE STANDARDS

A. General: All equipment, material, accessories, methods of construction and reinforcement, finish quality, workmanship and installation shall be in compliance with Section 23 05 01.

B. Certification: AMCA certified as to both sound and performance ratings, and in compliance with the requirements of ARI Standard 670.

C. NFPA: Standard 90A, "Installation for the Installation of Air Conditioning and Ventilating Systems".

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A.** General: Refer to Section 23 05 01.
1. Greenheck Fan and Ventilator Corp.
 2. Loren Cook Company
 3. Acme Engineering and Manufacturing Company

2.2 GENERAL

a. Bird Screen: Provide removable bird screens, 1/2" mesh, 16 ga. aluminum or brass wire on each fan unless otherwise noted on the drawings.

b. Backdraft Damper: Provide gravity-actuated louvered backdraft damper for each fan unless a motorized control damper is noted on the drawings. Damper blades shall be aluminum construction, with felt on the trailing edges to assure a tight closing seal.

c. Vibration Isolation: Isolate the entire rotating assembly and motor of each fan to prevent the transmission of vibration into the structure.

d. Fan Motor: Refer to Section 23 05 02. A disconnect switch inside the fan housing is not a requirement. Unless specifically indicated otherwise air handling unit fan motors shall be selected as follows:

1. Less than 5 hp; 135 percent of bhp
2. 5 Hp through 25 hp; 125 percent of bhp
3. Greater than 25 hp; 115 percent of bhp

e. V-Belt Drive: Refer to Section 23 05 03 for requirements for all belt driven fans.

f. Speed Control: Provide a solid-state speed controller for each direct drive motor. Speed controller shall enable full modulation of motor between 40-100% of nameplate capacity for fan balancing.

2.3 IN-LINE FAN

a. Centrifugal Type:

1. Housing: Fan housing including longitudinal, traverse, and diagonal stiffeners, motor mounts, bearing and drive supports shall be constructed of steel. Housing, including all bracing, stiffeners and motor mounting assembly shall be factory finished with a baked on alkyd enamel finish over a corrosion resistant primer. Provide a removable panel in bottom or side of housing for complete access to motor and fan.
2. Fan: Shall be centrifugal type and shall be statically and dynamically balanced.
3. Fan Motor: Permanently lubricated shaded pole motor mounted on resilient isolators to minimize vibration and noise.
4. Discharge Damper: Mounted in throat of fan discharge.

5. Drive Assembly: Drive shall be direct or v-belt type as indicated.
6. Speed Control: Solid state speed controller for speed reduction to 40 percent. Mounted on housing or as otherwise indicated.

b. Manufacturer: Greenheck, Cook, or Ilg.

2.4 CEILING CIRCULATION FAN

a. Manufacturer: Greenheck or equal.

2.5 SIDEWALL EXHAUST

a. propeller Type:

1. Fan Hood, Housing, and Base: Weatherproof and constructed of heavy gauge aluminum. Motor and drive: supported by a structural frame independent of hood, housing, and mounting frame.
2. Fan Wheel: Propeller, non-overloading, aluminum, air foil blade type, statically and dynamically balanced. Wheels: keyed and locked to shaft.
3. Drive Assembly: Motor and drive assembly located out of exhaust air stream, cushioned, mounted on multi-directional neoprene vibration isolators and positively ventilated. Direct or belt drive type as indicated.
4. Control: Fan shall be provided with motor starter with auxiliary contact for interlocking exhaust fan with intake louver motorized damper actuator. Mechanical contractor shall provide line voltage or motor rated thermostat for control of motor starter and louver damper actuator.

b. Manufacturer:

1. Greenheck
2. Cook
3. Ilg

PART 3 - EXECUTION

3.1 PLACEMENT AND MOUNTING

A. Installation: Fan location shall be as indicated, however, actual placement shall be verified using field measurements and data relating to the equipment approved for actual installation. Mount fan and backdraft damper in strict accordance with manufacturer's instructions.

3.2 SOUND AND VIBRATION CONTROL

A. Reference: Refer Section 23 33 00.

1. In-line Fan: Provide inlet and outlet flexible duct connections. Each fan shall be hung using neoprene vibration isolators.

3.3 OPERATING CONTROLS

A. Control Interlock: Interlock the exhaust fans with their associated light switch. Refer to electrical plans.

3.4 TEST AND BALANCE

A. Checkout: Operate all fans, adjust drive speeds to achieve design air flow, and perform other requirements as indicated in Section 23 08 00, PERFORMANCE VERIFICATION.

END OF SECTION 23 34 00

SECTION 23 37 13 - AIR DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Basic Requirements: Provisions of Section 23 05 01, BASIC MECHANICAL REQUIREMENTS are a part of this Section.

1.2 SUMMARY

A. General: Provide air distribution devices as indicated.

1.3 SUBMITTALS

A. General: Refer to paragraph entitled "SUBMITTALS" in Section 23 05 01. Include the following data:

- 1.** Manufacturers Literature:
 - a)** Photograph or rendering of each device
 - b)** Cut sheets showing the pressure drop, throw and noise levels at various air flows for each air distribution device.
 - c)** Color samples factory-applied to the same substrate as the finished product
- 2.** Performance Data: Static and total pressure drop, face velocity, throw and noise level for each of the air distribution devices at the air flows indicated.
- 3.** Installation Instructions: device including copies shipped with each air distribution device.

1.4 APPLICABLE STANDARDS

A. General: All equipment, material, accessories, methods of construction and reinforcement, finish quality, workmanship and installation shall be in compliance Section 23 05 01.

B. Air Diffusion Council (ADC): Laboratories used for testing the air flow performance of devices shall be approved by ADC.

C. ASHRAE: Standard 70-72, Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.

D. NFPA: Standard 90A, Installation of Air Conditioning and Ventilating Systems.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Manufacturer: Refer to Section 23 05 01.

2.2 GENERAL

A. Devices: Provide air distribution devices as indicated. All air distribution devices provided shall be the product of a single manufacturer unless specifically indicated otherwise.

B. Acoustical: Noise produced at each diffuser, register, grille or other air distribution device shall not exceed a noise criteria level of NC 35 based on sound pressure levels in db re 20 micropascals or as scheduled on the plans. Coordinate air distribution devices, sound attenuation measures and equipment provided to insure that the design acoustical constraints are not exceeded by the system, assuming a room absorption of 10 db re 1 pW.

C. Pressure Drop: Pressure drop across any air distribution device shall not exceed 0.10 inches of water gauge total pressure or as scheduled on the plans.

D. Material: All devices shall be constructed of extruded aluminum unless otherwise indicated. Air distribution devices installed in fire rated ceiling, floor/ceiling assembly, or rated wall shall be constructed of steel. Devices installed on hard surfaces (drywall or plaster ceilings or walls) shall have a neoprene gasket along each edge to provide an airtight seal.

E. Finish: Each air distribution device shall have a factory applied baked enamel finish. Devices shall be finished in white unless otherwise indicated.

F. Integral Components: All dampers, blank-off baffles and other companion devices which form an integral part of an air distribution device shall be factory-made.

G. Mounting Screws: Mounting screws which are visible on the face of grilles, diffusers or registers shall be furnished with the device and shall be finished at the factory to match the finish on the device on which they are used.

H. Manufacturer:

1. Titus
2. Price
3. Air Devices

2.3 CEILING AIR DISTRIBUTION

A. Round and Rectangular Devices: Devices indicated to be connected with flexible duct shall have a round neck or shall be provided with a factory supplied rectangle-to-round adapter; diffusers with metal duct connections may have round, square, or rectangular neck. Supply diffusers shall be furnished with a volume damper and adjustable equalizing grid unless otherwise noted; the volume damper shall be adjustable without removing the core.

1. Lay-in Ceiling Grid: Provide lay-in devices which are specifically manufactured to fit into ceiling module.
2. Surface Mounted; Lay-in Grid Ceiling: Provide air distribution devices with border styles which are compatible with adjacent ceiling systems.

2.4 SIDEWALL AIR DISTRIBUTION

A. Rectangular Devices: Unless otherwise indicated, supply, return and exhaust grilles and registers shall be extruded aluminum construction. All supply device blades shall be individually adjustable. Devices shall have an opposed blade damper, adjustable from the front of the device.

PART 3 - EXECUTION

3.1 GENERAL

A. Coordination: Coordinate the location of air distribution devices and reflected ceiling drawings with respect to placement and alignment to prevent conflict with lighting fixtures, fire protection sprinklers and smoke detectors. All rectangular ceiling devices shall be installed with their lines parallel and perpendicular to the building lines and aligned with the ceiling. Surface mounted devices shall be secured to and supported by metal duct branches or drops. Devices shall be supported by separate hangers where flexible duct connections are indicated.

B. Location: Install air distribution devices where indicated and in accordance with manufacturer's recommendations. The location of ceiling supply, return and exhaust air devices as shown on the designer's reflected ceiling drawings shall take precedence over any other location shown.

C. Exposed Duct and Device Interiors: Duct interiors, air distribution device interiors and blank-offs shall be painted with flat black enamel to eliminate light reflectance from the inside of the duct system.

D. Non-ducted Devices: Ceiling mounted devices without duct connections shall be provided with a mounting frame for incorporation into the ceiling system.

E. Support: All ducts connected to air distribution devices shall be supported independently of the ceiling. Verify the ceiling grid type being furnished. Lay-in devices shall be supported from the structure above if the suspended ceiling grid is not designed to carry the weight of the device.

F. Surface Mounted Devices; Lay-In Ceiling: Unless otherwise indicated, locate units in center of acoustical ceiling modules. Install square and parallel with the ceiling grid members and aligned vertically with the ceiling tile. The ceiling tile shall not be used to support any device.

G. Installation: Mount to the duct system flanges using screws provided by the device manufacturer, sealing the device to the duct system to prevent air leakage. Align adjustable blades to provide distribution without draft, pressure drop exceeding indicated value, or noise exceeding indicated values.

3.2 INSULATION

G. General: The exterior of all supply devices shall be insulated with a minimum of 3/4 inch elastomeric or 1 inch fiberglass blanket with vapor seal. The external insulation shall overlap any internal insulation a minimum distance of 4 inches. The vapor seal shall extend to the edge of the device. The overlap end shall seal against the duct and the exterior duct insulation vapor seal.

END OF SECTION 23 37 13

SECTION 23 81 26 - SPLIT SYSTEM HEAT PUMP UNIT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

a. Basic Requirements: Provisions of Section 23 05 01, BASIC MECHANICAL REQUIREMENTS, are a part of this Section.

1.2 SUMMARY

a. General: Provide labor, services, material and related items necessary to complete the installation of packaged air conditioning unit shown on the drawings or specified herein.

1.3 SUBMITTALS

a. General: Include the following data:

1. Manufacturers Literature:

a) Dimensional outline drawing showing the operating weights of the outdoor packaged equipment, all connection locations, and the distribution of the weight to the structure.

2. Performance Data: Sensible and total cooling capacities at the indicated design conditions for all packaged units.

3. Installation Instructions: Manufacturer's printed installation instructions including copies shipped with the equipment.

4. Maintenance Instructions: Manufacturer's printed maintenance instructions for equipment covered in this Section.

1.4 APPLICABLE STANDARDS

a. General: All equipment, material, accessories, methods of construction and reinforcement, finish quality, workmanship and installation shall be in compliance with Section 23 05 01.

b. NFPA: Insulation and adhesive shall meet the flame spread and smoke generation requirements of NFPA-90A.

c. ASHRAE: Packaged units shall be designed to conform to ASHRAE 15.

d. UL and CSA: Units shall be UL Listed and CSA Certified as a total package.

e. ARI: Capacities shall be rated in accordance with ARI Standard 210/240 or ARI Standard 360.

PART 2 - PRODUCTS

2.1 MANUFACTURER

a. General: Refer to Section 23 05 01. All products of a similar type shall be provided by the same manufacturer.

b. Acceptable Manufacturers:

1. Trane
2. Carrier Corporation
3. York

2.2 HEAT PUMP UNIT

a. General: The packaged equipment shall be specifically manufactured for outdoor applications. Capacity and energy efficiency shall not be less than indicated but no less than 12.8 EER. The air entering the condenser shall be 115 degrees F. unless otherwise indicated. Each unit shall be factory assembled and factory tested.

b. Cabinet: The cabinet shall be constructed of 16 gauge galvanized steel. Design of the cabinet shall allow access to compressor and all electrical connections. Asphalt or epoxy coating shall prevent water from reaching steel on the interior of the base bottom. Cabinet parts shall be cleaned and coated with zinc-phosphate or another suitable preparation, then painted with a baked enamel finish. All exterior hardware (nuts, bolts, screws, washers) shall be stainless steel.

c. Fans and Motors:

1. Condenser Fans: The condenser air fans shall be steel propeller type, dynamically balanced and direct-driven by a fan motor with pre-lubricated sealed ball bearings and built-in thermal overload protection. The condenser air discharge shall be provided with a vinyl coated or galvanized steel fan guard.

d. Compressors:

1. Type: Hermetic reciprocating or scroll compressor or serviceable semi-hermetic compressor shall have crankcase heater and equipped with internal overheat-overload protection. Semi-hermetic compressor shall be equipped with isolation valves and oil pressure failure protection. Provide reciprocating compressor only if scroll is not available in specified size.
2. Mounting: Compressors shall be provided with neoprene isolators and internal spring mounting on independent dedicated rails for vibration isolation.

e. Coils: The condenser coils shall be aluminum plate-finned formed on multiple rows of seamless copper tubing arranged in a staggered tube configuration and leak-tested to 300 psig. Exterior coil guards shall be galvanized or vinyl coated steel.

f. Refrigerant Components: Refrigerant shall be HFC-410a. Included in the refrigerant circuit shall be a condenser fan cycling head pressure control, accumulator, filter-drier, high pressure safety control (manual-reset), low pressure safety control/loss of charge protector (auto-reset), dual gauge connections for high and low pressure readings, sight glass-moisture indicator, reversing valves, and thermal-expansion valve. The expansion valve shall have adjustable superheat and distributors to meter the refrigerant evenly to the evaporator refrigerant circuits (air handler). Provide Schrader-type valve assembly with threaded cap for both liquid and suction lines to permit field testing and recharging.

g. Unit shall be factory prewired so that only power wiring to a fused disconnect furnished and mounted by the unit manufacturer and interlocking control wiring between a terminal block on the condenser and the indoor unit is required in the field. The internal wiring shall include fused disconnect switches and motor starters required for the air cooled condenser fan motors. An electrical interlock shall be provided to start the condenser fan motor when the compressor starts.

h. Control and Safeties:

1. Internally wired controls shall include the compressor anti-short cycle timer, compressor motor contactors or starters, high pressure cutout. The control circuit shall include a 24 volt transformer and low voltage terminal board.

2.3 AIR HANDLER UNIT

a. Cabinet: The cabinet shall be constructed of 16 gauge galvanized steel. The interior of the cabinet shall be thermally insulated with 3/4 inch thick fiberglass with antimicrobial coating.

b. Fans and Motors:

1. **Evaporator Fan:** The indoor fan shall be statically and dynamically balanced centrifugal blower and shall be made of galvanized steel. Blower wheel shall be mounted on a solid steel shaft supported by sealed ball bearings or regreasable-type with lubrication lines extended to the outside of the cabinet. Blower motors shall have pre-lubricated sealed ball bearings. The fan assembly shall be completely isolated from vibration.

c. Coils: The evaporator coils shall be aluminum plate-finned formed on multiple rows of seamless copper tubing arranged in a staggered tube configuration and leak-tested to 300 psig.

d. Condensate Drain Pan: The insulated condensate drain pan shall be non-corrosive. Connections shall be provided on both sides of unit and drain pan shall be sloped to drain connection.

e. Electric Heating Coil: Provide a factory-installed nickel-chrome electric heating coil. The coil shall be the open wire type. The installation shall include all internal wiring and branch circuit fusing. The coil shall have one stage of control with airflow cut-out switch and manual-reset high-temperature cut-out.

f. Filter Section: The filter section shall provide for 1-inch thick throwaway type filter installed in filter rack. Filter shall have MERV 7 efficiency. The filter shall be accessible through an insulated and gasketed access door in the side of the unit.

g. Power Wiring: The unit shall be provided with factory-installed branch circuiting for a single point of termination requiring only one field connection for power wiring. Blower fan and electric heating coil shall be individually fused.

h. Controls and Safeties:

1. Control: Cooling/heating shall be controlled by a factory-provided programmable thermostat. Thermostat shall have occupancy schedule, setback, and auto-changeover features. Two stage thermostat shall automatically switch from heat pump mode to electric resistance heating when demand is not met and shall automatically switch back to heat pump operation upon return to setpoint.
2. Blower Operation: Blower operation shall cycle with condensing unit to maintain space temperature setpoint.
3. Firestat: Provide a firestat in the return air to the unit to de-energize the unit when the temperature rises to above 145 degrees F.

PART 3 - EXECUTION

3.1 GENERAL

a. Placement: The equipment location shall be as shown; however, actual placement shall be verified using field measurements and data relating to the equipment accepted for actual installation on the project in order to avoid conflict with the structure and the access to or location of other equipment.

b. Clearance: Layout and carefully install units with sufficient clearances to permit proper maintenance. The space required shall be as recommended by the manufacturer including the space required for removal of the for maintenance.

c. Coordination: Coordinate with ductwork, electrical connections and controls for a neat workmanlike installation.

3.2 WARRANTY

a. Extended Warranty: Each compressor shall be provided with a 5-year extended warranty. The warranty period shall commence upon the date of substantial completion.

END OF SECTION 23 81 26

SECTION 23 82 39 - HEATING TERMINAL UNIT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Basic Requirements: Provisions of Section 23 05 01, BASIC MECHANICAL REQUIREMENTS, are a part of this Section.

1.2 SUMMARY

A. General: Provide downflow heaters as indicated.

1.3 SUBMITTALS

A. General: Include the following data:

1. Manufacturers Literature:

- a)** Dimensional outline drawing for each heating unit showing the location of all equipment connections
- b)** Unit weight and support data for each type and size
- c)** Wiring diagram including power connections, controls and safety devices

2. Performance Data:

- a)** Fan cfm, speed, horsepower and electrical characteristics for each unit
- b)** Heating capacity, MBh input, output and number of stages.

3. Installation Instructions: Manufacturer's printed instructions for the installation of each heating terminal unit including copies shipped with the equipment.

4. Maintenance Instructions: Manufacturer's printed maintenance instructions for each heating terminal unit.

1.4 APPLICABLE STANDARDS

A. General: All equipment, material, accessories, methods of construction and reinforcement, finish quality, workmanship and installation shall be in compliance with Section 23 05 01.

B. UL: Gas-fired downflow heaters shall be Underwriters' Laboratory listed and certified by AGA and CGA.

PART 2 - PRODUCTS

2.1 GAS-FIRED DOWNFLOW HEATERS

a. General: Gas-fired downflow heaters shall be designed for vertical mounting as indicated. Units shall be rated for 82% thermal efficiency or greater.

b. Casing: The casing shall be constructed of steel and finished in baked enamel. Adjustable louvers shall be provided to control the direction of the air flow. The hinged access door shall be secured in position by captive fasteners.

c. Heat Exchanger: The heat exchanger shall be titanium stabilized aluminum steel, tubular finned type.

d. Fan and Motor: Fan motors shall have permanently lubricated bearings, built-in thermal protection and be completely enclosed. Fans shall be aluminum, direct drive, propeller designed for quiet operation. Fan speed shall not exceed 1,600 rpm. Provide OSHA guard.

e. Venting: AGA certified for Categories I and III requirements.

f. Controls: Control circuit transformers shall be factory installed and wired. 24 volt solid-state control with intermittent pilot ignition. Two stage low voltage remote-mounted thermostat with locking cover for downflow heaters.

g. Manufacturers:

1. Reznor

2. Modine

3. The Trane Company

PART 3 - EXECUTION

3.1 GENERAL

A. Placement: Each unit shall be supported by ceiling brackets furnished by the manufacturer. The location of the units shall be as shown; however, actual placement shall be verified to avoid conflict with the structure and the access to or with location of other equipment.

B. Clearance: Layout and carefully install units with sufficient clearances to permit proper maintenance. The space required shall be as recommended by the manufacturer including the space required for removal of the fan and motor for maintenance.

C. Vibration Mounting: Provide hangar mount vibration spring isolator similar to Mason 5C or equal.

D. Coordination: Coordinate the electrical connections and controls for a neat workmanlike installation.

END OF SECTION 23 82 39

SECTION 26 01 60 OPERATION AND MAINTENANCE MANUALS

PART 1- GENERAL

1.1 RELATED DOCUMENTS

a. Drawings and general provisions of the Contract, including Contractual Conditions and Division 01 Specification sections apply to this section.

b. General: Refer to Closeout requirements related to the preparation and contents of Operation and Maintenance manuals/CDs.

1.2 OPERATION AND MAINTENANCE MANUALS

a. The various specification sections of Division 26 contain specific information to be included in the O&M manuals/CDs in addition to the general requirements outlined in Section 01 78 00.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 26 01 60

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SECTION 26 05 19 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1- GENERAL

1.1 RELATED DOCUMENTS

a. Drawings and general provisions of the Contract, including Contractual Conditions and Division 01 Specification sections apply to this section.

1.2 SUMMARY

a. This section includes the requirements for provision and installation of Building Wire and Cable.

1.3 DESCRIPTION

a. Provide all equipment, labor, material, accessories, and mounting hardware to properly install all conductors and cables rated 600 volts and less for a complete and operating system for the following:

1. Building wire and cable.
2. Wiring connectors and connections.

b. No aluminum conductors shall be permitted.

c. All sizes shall be given in American Wire Gauge (AWG) or in thousand circular mils (MCM/KCMIL).

1.4 SUBMITTALS

a. Product Data: Submit catalog cut sheet showing, type and UL listing of each type of conductor, connector and termination.

1.5 QUALIFICATIONS

a. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years experience.

1.6 REFERENCES AND REGULATORY REQUIREMENTS

a. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

b. Conform to the requirements of ANSI/NFPA 70.

1.7 PROJECT CONDITIONS

a. Verify that field measurements are as shown on Drawings.

b. Conductor sizes are based on copper.

c. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.

d. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required. Record actual routing on red lined as-builts.

e. Conductors with different voltages (i.e. 120 volt and 277 volt) shall not be combined in the same conduit without prior written approval from Engineer.

1.8 COORDINATION

a. Determine required separation between cable and other work.

b. Coordinate cable routing to avoid interference with other work disciplines.

PART 2 - PRODUCTS

2.1 BUILDING WIRE AND CABLE

a. Description: Single conductor insulated wire.

b. Conductor: Copper.

c. Insulation Voltage Rating: 600 volts.

d. Insulation: ANSI/NFPA 70, Type THHN/THWN and XHHW.

e. Cable supports shall be O Z/Gedney Type "S" or approved substitution.

PART 3 - EXECUTION

3.1 GENERAL

- a. Install products in accordance with manufacturer's instructions.
- b. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- c. Before installing raceways and pulling wire to any mechanical equipment, verify electrical characteristics with final submittal on equipment to assure proper number and AWG of conductors. (As for multiple speed motors, different motor starter arrangements, etc.).
- d. Conductors #12 AWG shall be 600 volt type THHN/THWN, solid unless specifically noted otherwise, rated 90 degrees C. dry.
- e. Use conductors not smaller than 12 AWG for power and lighting circuits.
- f. Provide dedicated neutral conductor for each branch phase conductor for 120V and 277V circuits (power and lighting). Multi-pole breakers to comply with NEC 210.4 are not permitted.
- g. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet (23 m).
- h. Use 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet (61 m).
- i. All conductors shall be installed in raceway.
- j. Conductor sizes indicated on circuit homeruns or in schedules shall be installed over the entire length of the circuit unless noted otherwise on the drawings or in these specifications.
- k. Coordinate all wire sizes with lug sizes on equipment, devices, etc. Provide/install lugs as required to match wire size.
- l. Where oversized conductors are called for due to voltage drop, etc., provide/install lugs as required to match conductors, or provide/install splice box, and splice to reduce conductor size to match lug size.

3.2 EXAMINATION

- a. Verify that interior of building has been protected from weather.

- b. Verify that mechanical work likely to damage wire has been completed.

3.3 PREPARATION

- a. Completely and thoroughly swab raceway before installing wire.

3.4 WIRING METHODS

- a. Use only building wire, Type THHN/THWN insulation, in raceway unless noted otherwise.
- b. Wiring in vicinity of heat producing equipment: Use only XHHW insulation, in raceway.
- c. Conductors installed within fluorescent fixture channels shall be Type THHN or XHHW, rated 90 degrees C dry. Conductors for all other light fixtures shall have temperature ratings as required to meet the UL listing of the fixture; however, in no case shall the temperature rating be less than 90 degrees Centigrade. Remove incorrect insulation types in new work.

3.5 INTERFACE WITH OTHER PRODUCTS

- a. Identify wire and cable under provisions of Section 26 05 53 Identification for Electrical Systems.
- b. Identify each conductor with its circuit number or other designation indicated on Drawings.
- c. Identify neutrals with its associated circuit number(s) per NEC Article 210.4(D).

3.6 FIELD QUALITY CONTROL

- a. Perform field inspection and testing under provisions of the General Requirements of the Contract Documents and Section 26 08 10 Tests and Performance Verification.
- b. Inspect wire for physical damage and proper connection.
- c. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.
- d. Verify continuity of each branch circuit conductor.
- e. Submit "Conductor Insulation Resistance Test" form as required in Section 26 08 10.

3.7 VERTICAL RISERS

a. Provide vertical cable riser supports per Article 300-19 in NFPA 70. These shall be located in accessible pullboxes of adequate size. Provide for adequate structural connection of cable supports to pullbox, which will transfer cable weight to building.

3.8 PULLING

a. No wire shall be pulled until the conduit system is complete from pull point to pull point and major equipment terminating conduits have been fixed in position.

b. Mechanical pulling devices shall not be used on conductors sized #8 and smaller. Pulling means which might damage the raceway shall not be used.

c. Use only powdered soapstone or other pulling lubricant acceptable to Engineer. Compound or lubricant shall not cause the conductor or insulation to deteriorate.

d. All conductors to be installed in a common raceway shall be pulled together. The manufacturer's recommended pulling tensions shall not be exceeded.

e. Bending radius of insulated wire or cable shall not be less than the minimum recommended by the manufacturer.

f. Where coaxial type conductors are installed, special requirements shall apply as outlined under that specific system detail specifications.

g. Where control or signal circuits with a lower insulation rating enter an enclosure with conductors having a 600 volt or higher insulation rating, a separate wire way will be installed or proper clearance distance will be maintained per NEC.

h. All conductors shall be pulled in conduits by industry approved cable pulling "tuggers" equipment. The use of construction equipment such as fork lifts, tractors and other vehicles will not be allowed. All conductors will be routed and protected by using the proper pulleys and sheaves.

3.9 CONTROL AND SIGNAL CIRCUITS

a. For control and signal circuits above 50 VAC, conductors shall be #14 AWG minimum size, Type XHHW or THHN/THWN as permitted by NFPA 70, within voltage drop limits, increased to #12 AWG as necessary for proper operation.

b. For control and signal circuits 50 VAC and below, conductors, at the Contractor's option, may be #16 AWG, 300 volt rated, PVC insulated, except where specifically noted otherwise in the contract documents.

c. Conductor insulation for fire alarm systems shall be as approved by Code Inspection Authority only. Wire approvals by the Engineer shall not supersede this final approval for conditions of this specific project.

d. Install circuit conductors in conduit.

e. Circuit conductors #10AWG and larger to be stranded.

3.10 COLOR CODING

a. All power feeders and branch circuits No. 6 and smaller shall be wired with color-coded wire with the same color used for a system throughout the building. Power feeders above No. 6 shall either be fully color-coded or shall have black insulation and be similarly color-coded with tape in all junction boxes and panels. Tape shall completely cover the full length of conductor insulation within the box or panel.

b. Unless otherwise approved or required by DESIGNER to match existing, color-code shall be as follows: Neutrals to be white for 120/208V system, natural grey for 277/480V system; ground wire green, bare or green, insulated ground conductor green with yellow tracer. 120/208V, Phase A - black; Phase B - red; Phase C - blue. 480/277V, Phase A brown; Phase B - orange; Phase C - yellow. All switch legs, other voltage system wiring, control and interlock wiring shall be color-coded other than those above.

3.11 TAPS/SPLICES/CONNECTORS/TERMINATIONS

a. Taps and splices are not acceptable unless specifically noted otherwise on drawings or special written approval is granted by Engineer. (See 3.1K) Submit locations, sizes, etc., where taps will be necessary to coordinate with lug sizes/quantities for review and approval prior to installation.

b. Clean conductor surfaces before installing lugs and connectors.

c. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

d. Power and lighting conductors shall be continuous and unspliced where located within conduit. Splices shall occur within troughs, wireways, outlet boxes, or equipment enclosures where sufficient additional room is provided for all splices. No splices shall be made in in-ground pull boxes.

e. Splices in lighting and power outlet boxes, wireway, and troughs shall be kept to a minimum, pull conductors through to equipment, terminal cabinets, and devices.

f. No splices shall be made in junction box, and outlet boxes (wire No. 8 and larger) without written approval of Engineer.

g. No splices shall be made in communications outlet boxes, pull boxes or wireways (i.e., fire alarm, computer, telephone, intercom, sound system, etc.) without written approval of Engineer. Pull cables through to equipment cabinets, terminal cabinets and devices.

h. No splices shall be made in circuits of #8 AWG conductors or larger of 1000 feet or less without written approval of the Engineer.

i. Allow adequate conductor lengths in all junction boxes, pull boxes and terminal cabinets. All termination of conductors in which conductor is in tension will be rejected and shall be replaced with conductors of adequate length. This requirement shall include the providing by the Contractor of sleeve type vertical cable supports in vertical raceway installations provided in pullboxes at proper vertical spacings.

j. A calibrated torque wrench shall be used for all bolt tightening. A torque mark should be used after torqueing is performed. Torque mark should consist of a permanent mark over the mechanical lug, bolt, nut, etc.

k. Interior Locations:

1. All (non-electronic systems) copper taps and splices in No. 8 or smaller shall be fastened together by means of "Screw-on spring type (wire nut)" connectors. All "Push-in" or "Stab-in" type connectors are prohibited. All taps and splices in wire larger than No. 8 shall be made with compression type connectors approved by OAR and taped to provide insulation equal to wire.

l. Exterior Locations:

1. Make splices, taps and terminations above grade in splice or termination cabinets. Do not splice any cable in ground or below finished grade.
2. All taps and splices shall be made with compression type connectors approved by Engineer and covered with insulating material equivalent to conductor insulation or be terminated/connected to terminal strips in above grade terminal boxes suitable for use.
3. Provide and install above grade termination cabinets sized to meet applicable codes and standards, where required for splicing.

END OF SECTION 26 05 19

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SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

a. Drawings and general provisions of the Contract, including Contractual Conditions and Division 01 Specification sections apply to this section.

1.2 SUMMARY

a. This section includes the requirements for provision and installation of grounding and bonding.

1.3 DESCRIPTION

a. Provide all labor, materials, and equipment necessary to properly install a grounding system conductor in all new branch wiring and feeder installations that shall be in full compliance with all applicable Codes as approved by the authorities having jurisdiction. The secondary distribution system shall include a grounding conductor in all raceways in addition to the return path of the metallic conduit.

b. In general, all electrical equipment (metallic conduit, motor frames, panelboards, etc.) shall be bonded together with a green insulated or bare copper system grounding conductor in accordance with specific rules of Article 250 of the N.E.C. and State codes. Bonding conductor through the raceway system shall be continuous from main switch ground bus to panel ground bar of each panelboard, and from panel grounding bar of each panelboard to branch circuit equipment and devices.

c. All raceways shall have an insulated copper system ground conductor throughout the entire length of circuit installed with-in conduit in strict accordance with NEC. Grounding conductor shall be included in total conduit fill determining conduit sizes, even though not included or shown on drawings. Grounding conductors run with feeders in PVC conduit outside of building(s) shall be bare only.

d. Section Includes

1. Grounding electrodes and conductors.
2. Equipment grounding conductors.
3. Bonding.
4. Ground Ring.

1.4 SUBMITTALS

a. Submit catalog cut sheet showing brand and selection for all conductors, test wells, components, etc., as specified herein showing that all materials are UL listed and labeled as applicable and manufactured in the United States.

b. Product data shall prove compliance with Contract Documents, National Electric Code, Underwriters Laboratories, manufacturer's specifications, manufacturer's written installation data and compliance with all performance criteria.

c. Include instructions for storage, handling, protection, examination, preparation, operation and installation of product.

d. Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements.

e. Show all dimensions, colors, configurations, covers and applicable labeling/stamping.

f. Record actual locations of grounding electrodes on red lined as-built documents.

g. Submit test results of each ground rod.

1.5 REFERENCES AND REGULATORY REQUIREMENTS

a. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

b. Conform to requirements of ANSI/NFPA 70 - National Electrical Code.

PART 2 - PRODUCTS

2.1 ROD ELECTRODE

a. Material: Copper-clad steel.

b. Diameter: 5/8 inch.

c. Length: 20 feet minimum. Increase lengths as required to achieve specified resistance.

2.2 MECHANICAL CONNECTORS

a. All grounding connectors shall be in accordance with UL 467 and UL listed for use with rods, conductors, reinforcing bars, etc., as appropriate.

b. Connectors and devices used in the grounding systems shall be fabricated of copper or bronze materials, and properly applied for their intended use. Specified items of designated manufacturers indicate required criteria and equal products may be provided if approved. All connectors and devices shall be compatible with the surfaces being bonded and shall not cause galvanic corrosion by dissimilar metals. Materials in items not listed herein shall be of equal quality to the following specified items:

- 1.** Lugs: substantial construction, of cast copper or cast bronze, with "ground" (micro-flat) surfaces equal to Burndy QQA-B Series, two hole, T&B, or approved substitution. Light weight and "competitive" devices shall be rejected.
- 2.** Grounding and Bonding Bushings: Malleable iron, Thomas and Betts (T&B), or approved substitution.

3. Piping Clamps: Burndy "GAR-TC series" with two hole compression lug under U-Bolt nut, or T&B, or approved substitution.
4. Grounding Screw and Pigtail: Raco No. 983 or approved substitution.
5. Fastening hardware: Grade 5 silicone bronze with beveled washers. Copperplate is not acceptable

c. Mechanical lugs or wire terminals shall be used to bond ground wires together or to junction boxes and panel cabinets and shall be manufactured by Anderson, Buchanan, Thomas and Betts Co., or Burndy.

2.3 WIRE

- a. Material: Stranded copper.
- b. Size: Size to meet NFPA 70 requirements as a minimum, increase size if called for on drawings, in these specifications, or as required for voltage drop.
- c. Insulated THWN (or bare as noted elsewhere).

2.4 GROUNDING WELL COMPONENTS

- a. Grass Non-Traffic Areas:
 1. Well: Minimum 12 inch long by 12 inch wide by 18 inches deep with open.
 2. Well Cover: High density plastic, composolite, or cast iron with legend "GROUND" embossed on cover.
 3. Material: Structural Plastic, composolite, or concrete.
 4. Manufacturer: Brooks Products 70 Series or equal by Quazite or approved substitution.
 5. Increase depth, diameter or size as required to provide proper access at installed location.
- b. Paving and Low Traffic Areas:
 1. Well: Minimum 12 inch long by 12 inch wide by 18 inches deep with open bottom.
 2. Well Cover: Traffic rated for use with "GROUND" embossed on cover.
 3. Material: Composolite.
 4. Manufacturer: Quazite or approved substitution.
 5. Increase depth, diameter or size as required to provide proper access at installed location.

2.5 GROUNDING BARS/GROUND BUS (INCLUDING 'SYSTEMS' GROUND BUS/BARS AND GROUND BUS BARS)

a. Ground bars shall be copper of the size and description as shown on the drawings. If not sized on drawings, bus bar shall be minimum 1/4" x 2" bus grade copper, spaced from wall on insulating 2" polyester molded insulator standoff/supports, and be 12" or greater minimum overall length, allowing 2" length per lug connected thereto. Increase overall length as required to facilitate all lugs required while maintaining 2" spacing. Size of bus bar used in main electrical room shall be similar except minimum of 4" high and 24" long.

b. Provide bolt tapping lug with two hex head mounting bolts for each terminating ground conductor, sized to match conductors. Mount on bus bar at 2 inches on center spacing. Lugs to be manufactured by Burndy, T&B or approved substitution.

c. Bus bar shall have rows of holes in accordance with NEMA Standards for specified lugs.

d. Standoff supports to be 2" polyester as manufactured by Glastic #2015-4C or approved substitution.

PART 3 - EXECUTION

3.1 GENERAL

a. Install products in accordance with manufacturer's instructions.

b. Install grounding electrodes conductor, bonding conductors, ground rods, etc. with all required accessories.

c. Grounding shall meet (or exceed as required to meet these specifications) all the requirements of the N.E.C., the NFPA, and applicable standards of IEEE.

d. Where there is a conflict between these specifications and the above applicable codes or standards, or between this section and other specifications sections then the most stringent or excessive requirement shall govern. Where there is an omission of a code/standard requirement in these specifications then the code/standard requirements shall be complied with.

e. Requirement in these specifications to comply with a specific code/standard article, etc. is not to be construed as deleting of requirements of other applicable codes/standards and their articles, etc.

f. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.2 GROUNDING ELECTRODES

a. All connections shall be exothermic welded unless otherwise noted herein. All connections above grade and in accessible locations may be by exothermic welding or by brasing or clamping with devices UL listed as suitable for use except in locations where exothermic welding is specifically specified in these specifications or called for on drawings.

b. Each rod shall be die stamped with identification of manufacturer and rod length.

c. Install rod electrodes at locations indicated and/or as called for in these specifications.

d. Ground Resistance:

1. Main Electrical Service (to each building and Site) and Generator Locations:

a) Grounding resistance measured at each main service electrode system and at each generator electrode system shall not exceed 5 ohms.

2. Lightning Protection Ground Locations:

a) Lightning Protection system ground locations shall not exceed 5 ohms measured at ground electrode.

3. Site Distribution Counterpoise Ground Locations:

a) Counterpoise system ground locations shall not exceed 25 ohms measured at ground electrode.

4. Other Locations:

a) Resistance to ground of all non-current carrying metal parts shall not exceed 25 ohms measured at motors, panels, busses, cabinets, equipment racks, light poles, transformers, and other equipment.

5. Resistance called for above shall be maximum resistance of each ground electrode prior to connection to grounding electrode conductor. Where ground electrode system being measured consists of two (2) or more ground rod electrodes at each location, then the resistance specified above shall be the maximum resistance with two (2) or more rods connected together but not connected to the grounding electrode conductor.

e. Install additional rod electrodes as required to achieve specified resistance to ground (specified ground resistance is for each ground rod location prior to connection to ground electrode conductor).

f. Provide grounding well with cover at each rod location, with the only exception being a site distribution counterpoise ground rod. Install grounding well top flush with finished grade.

g. Install ground rods not less than 1 foot below grade level and not less than 2 feet from structure foundation.

3.3 GROUND RESISTANCE AT LOCATION OTHER THAN LOCATION OF GROUNDING ELECTRODES.

a. Resistance to ground of all non-current carrying metal parts shall not exceed 25 ohms measured at motors, panels, busses, cabinets, equipment racks, light poles, transformers, and other equipment.

3.4 GROUNDING ELECTRODE CONDUCTOR

a. Conductor shall be sized to meet (or exceed requirements of Contract Documents) the requirements of NEC 250.66.

3.5 EQUIPMENT GROUNDING CONDUCTOR

a. Grounding conductors shall be provided with every circuit to meet (or exceed requirements of Contract Documents) the requirements of NEC 250.122.

b. At every voltage level, new portions of the electrical power distribution system shall be grounded with a dedicated copper conductor which extends from termination back to power source in supply panelboard.

c. Provide separate, insulated (bare if with feeder in PVC conduit) conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

d. Except as otherwise indicated, each feeder raceway on the load side of the service entrance shall contain a ground conductor sized as indicated and where not shown shall be sized to meet (or exceed requirements of Contract Documents) the requirements of NEC 250.122. Conductor shall be connected to the equipment grounding bus in switchboards and panelboards, to the Grounding Bus in all motor control centers, and as specified, to lighting fixtures, motors and other types of equipment and outlets. The ground shall be in addition to the metallic raceway and shall be connected, using a lug device located within each item enclosure at the point of electric power connections to permit convenient inspection.

e. Provide green insulated ground wire for all grounding type receptacles and for equipment of all voltages. In addition to grounding strap connection to metallic outlet boxes, a supplemental grounding wire and screw equal to Raco No. 983 shall be provided to connect receptacle ground terminal to the box.

f. All plugstrips and metallic surface raceway shall contain a green insulation ground conductor from supply panel ground bus connected to grounding screw on each receptacle in strip and to strip channel. Conductor shall be continuous.

g. Where integral grounding conductor is specified elsewhere in bus duct construction, provide equivalent capacity conductor from supply switchboard or panelboard grounding bus to the bus duct grounding conductor. Bond integral conductor to bus duct enclosure at each tap and each termination.

h. All motors, all heating coil assemblies, and all building equipment requiring flexible connections shall have a green grounding conductor properly connected to the frames and extending continuously inside conduit with circuit conductors to the supply source bus with approved connectors regardless of conduit size or type. This shall include "Equipment By Owner" to which an electric conduit is provided under this Division.

3.6 MAIN ELECTRICAL SERVICE

a. Complete installation shall meet or exceed the requirements of the NEC 250.

b. Artificial electrodes shall be provided for the main service in sufficient number and configuration to secure resistance specified.

c. Provide and bond to all of the following:

1. Ground rods.
2. Metal water pipe.
3. Building metal frame, structural steel or reinforced structural concrete.
4. Encased Electrodes.
5. Ground ring.
6. Site distribution counterpoise ground system.
7. Lightning protection system.

d. A main ground, bare copper conductor, sized per NEC Table 250.66, but in no case less than #2/0, shall be run in conduit from the main switchgear of each building to the building steel in respective building. This ground conductor shall also be run individually from the main switchgear and be bonded to the main water service ahead of any union in pipe and must be metal pipe of length and location as acceptable by authorities having jurisdiction. Provide properly sized bonding shunt around water meter and/or dielectric unions in the water pipe. Also required is the same size ground wire to ground rod electrode as called for below:

1. Three 30 ft. ground rods in a delta configuration at no less than 30 ft. spacing driven to a minimum depth of 30 feet, one foot below grade.
2. Bond ground rod electrodes together with a bare copper ground conductor that matches size required by NEC Table 250.66, but in no case less than #2/0.
3. Provide additional rod electrodes as required to achieve specified ground resistance.

e. Ground/bond neutral per NEC 250.

f. A main ground, bare copper conductor, sized per applicable Table in NEC 250, but in no case less than #2/0, shall be run in conduit from the main switchgear of each building to a concrete encased electrode per NEC 250.52(3).

g. Bond grounding electrodes to site counterpoise grounding system and lightning protection system where provided.

h. Provide and install ground bus bar on wall near main service disconnect/switchboard. Connect to ground bar in disconnect/switchboard bonded to switchboard/disconnect enclosure/neutral with copper grounding conductor sized per NEC Table 250.66.

3.7 TRANSFORMER GROUNDING

c. Ground all transformers and enclosures of 120/208V and 277/480V "separately derived systems" as specified herein.

1. Ground per NEC 250 and these specifications.

2. Bond neutral to transformer frame/enclosure and the equipment grounding conductors of the derived system with copper ground conductor sized per NEC Table 250.66.
3. Connect transformer neutral/ground to grounding electrode per NEC 250.30 with grounding electrode conductor sized per NEC Table 250.66.
4. In addition to connection to grounding electrode conductor called for above, provide supplemental grounding electrode as follows:
 - a) Where grounding required per NEC 250.30 is to building steel/structure, supplement this grounding with connection to nearest available effectively grounded metal water pipe.
 - b) Where grounding connection required per NEC 250.30 is to grounded metal water pipe, supplement with connection to building steel/structure in addition to any other available electrodes specified in NEC 250.50 and 250.52.
 - c) Where supplemental grounding electrodes required above is a ground rod electrode, provide two or more 30 ft. ground rod electrodes at no less than 30 ft. spacing, driven full length into the earth one foot below grade.
5. Where neither building steel nor water pipe grounding electrodes are available (i.e. exterior locations with no available water pipe electrode) provide two (2) ground connections: each 30 ft. ground rod electrodes at not less than 30 ft. spacing, driven full length into the earth one foot below grade.
6. Where transformer is mounted to exterior of building, one (1) of the two (2) ground electrodes required shall be ground rod electrode as called for in 5. above. This ground rod electrode shall also be connected to counterpoise system.
 - d. Provide additional ground electrodes as required to achieve specified ground resistance.
 - e. Where two or more ground electrodes are used at any required ground location, they shall be bonded together with a copper ground conductor, sized to meet NEC Table 250.66, but in no case less than #2/0.
 - f. Complete installation shall meet or exceed the minimum requirements of NEC 250.
 - g. Equipment ground conductors shall be provided in addition to above grounding. See 'EQUIPMENT GROUNDING CONDUCTOR', NEC 250.122.
 - h. Provide ground bus bar on wall near transformer (or in associated electrical room for exterior mounted transformers). Connect to ground lug in transformer bonded to transformer enclosure/neutral with copper ground conductor sized per NEC Table 250.66.
 - i. Multiple separately derived systems may be grounded as allowed in NEC 250-30(A)(4).

3.8 LIGHTNING PROTECTION SYSTEMS

c. Ground per Section 26 41 13 – Lightning Protection for Structures, NFPA 780, and as specified herein. The most stringent requirements shall govern.

d. Bond lightning protection system grounds to electrical service system ground, and counterpoise system ground where provided.

3.9 EXTERIOR GRADE (OR FREE STANDING ABOVE GROUND) MOUNTED EQUIPMENT

c. General:

1. All equipment mounted exterior to building shall have their enclosures grounded directly to a grounding electrode at the equipment location in addition to the building equipment ground connection.
2. Bond each equipment enclosure, metal rack support, mounting channels, etc. to ground electrode system at each rack with an insulated copper ground conductor sized to match the grounding electrode conductor required by NEC Table 250.66 based on equipment feeder size, but in no case shall conductor be smaller than #6 copper or larger than #2 copper. This connection is in addition to grounding electrode connections required for services.

d. Main electrical service rack mounted equipment.

1. Ground per "MAIN ELECTRICAL SERVICE".
2. Bond all metal parts as noted in this section.

e. Electrical sub service rack mounted equipment.

1. Ground per "MAIN ELECTRICAL SERVICE", except do not bond neutral to ground.
2. Bond all metal parts as noted in this section.

f. Electrical equipment connection rack mounted equipment.

1. Bond all metal parts as noted in this section.

g. Grounding electrodes (ground electrodes system) shall be:

1. Located at each rack location.
2. For service equipment: Ground electrode required per "MAIN ELECTRICAL SERVICE".
3. For equipment connection: Two or more 30 ft. ground rods at no less than 30 ft. spacing, driven vertical to a minimum depth of 30 ft. plus 1 ft. below grade. Bond ground rods together with a size to meet NEC Table 250.66, but no less than a #2 copper ground conductor. Provide additional rod electrodes as required to achieve specified ground resistance.

h. Complete installation shall meet or exceed the minimum requirements of NEC 250 and, when applicable, NFPA 78.

3.10 ROOF MOUNTED EQUIPMENT

a. Bond all roof mounted electrical equipment to lightning protection system (when provided) per NFPA 780.

3.12 LIGHTING FIXTURES

a. All new and reinstalled fixtures shall be provided with green grounding conductor, solidly connected to unit. Individual fixtures grounds shall be with lug to fixture body, locate at point of electrical connection to the fixture unit.

b. All suspended fixtures and those supplied through flexible metallic conduit shall have green ground conductor from outlet box to fixture. Cord connected fixtures shall contain a separate green ground conductor.

c. Pole Light Fixtures:

1. Metal Pole Light Fixtures:

- a)** Freestanding pole mounted lighting fixtures shall each have a - Class I or Class II Materials - lightning protection main copper down conductor connected to grounding electrodes at base of pole.
- b)** Conductor shall be bonded to metal pole via UL Listed ground clamp suitable for use. Locate ground lug opposite to handhole (or adjacent if visible through handhole).

2. Concrete or Non-Metallic Pole:

- a)** Freestanding pole mounted lighting fixtures shall each have a Class I or Class II lightning protection main copper down conductor connected to grounding electrodes at base of pole.
- b)** Conductor shall be extended from grounding electrode to top of pole and terminate at the top of pole in a Class I or Class II copper lightning protection air terminal.
- c)** Each metal part of light fixture assembly, bracket, ballast cabinet, disconnect, transformer, etc. that is mounted to pole shall be bonded to down conductor.

3. Fixtures located on elevated roadway ramps: provide with a connection to lightning counterpoise grounding system.

4. Grounding electrode(s) at each pole shall be bonded to site distribution counterpoise system.

5. Grounding Electrodes:

- a) Two or more 30 ft. ground rods at no less than 30 ft. spacing shall be driven full length into the earth one foot below grade.
 - b) Bond ground rod electrodes together with a Class I or Class II lightning protection main copper conductor.
 - c) Provide additional rod electrodes as required to achieve specified ground resistance.
 - d) Two (2) or more grounding rod electrodes shall be installed at each light pole.
6. Installation shall exceed minimum requirements of NFPA 780.

3.13 HAZARDOUS LOCATIONS

a. Grounding in hazardous locations shall be done in accordance with applicable portions of Articles 500, 501, 502, 503, 511 and 514 of the National Electrical Code.

3.14 GROUND RING

- a. Provide complete underground building perimeter ground ring system, completely encircling building.
- b. Install minimum 2-1/2 feet depth into earth.
- c. Install ground rods (minimum 30 ft. long) every 150 feet section of ground ring conductor.
- d. Bond ground ring to building steel every 150 feet of building perimeter, bond to any and all electrical and piping systems that cross the ground ring system, bond to lightning protection down conductors and to any lightning or other earth grounding electrodes that may be present on the premises.
- e. Bond to building service.

3.15 MISCELLANEOUS GROUNDING CONNECTIONS

- a. Provide bonding to meet regulatory requirements.
- b. Required connections to building steel shall be with UL approved non-reversible crimp type ground lugs exothermically welded to bus bar that is either exothermically welded to steel or bolted to steel in locations where weld will affect the structural properties of the steel.
- c. Install grounding conductors to permit shortest and most direct path from equipment to ground; install in conduit; bond to conduit at both ends when conduit is metal; have connections accessible for inspection; and made with approved solderless connectors brazed (or bolted) to the equipment ground; in NO case be a current carrying conductor; have a green jacket unless it is bare copper; be run in conduit with power and branch circuit conductors. The main grounding electrodes conductor shall be exothermically welded to ground rods, water pipe, and building steel.

d. All surfaces to which grounding connections are made shall be thoroughly cleaned to maximum conductive condition immediately before connections are made thereto. Metal rustproofing shall be removed at grounding contact surfaces, for 0 ohms by digital Vm. Exposed bare metal at the termination point shall be painted.

e. All ground connections that are buried or in otherwise inaccessible locations, shall be welded exothermically. The weld shall provide a connection which shall not corrode or loosen and which shall be equal or larger in size than the conductors joined together. The connection shall have the same current carrying capacity as the largest conductor.

f. Install ground bushings on all metal conduits entering enclosures where the continuity of grounding is broken between the conduit and enclosure (i.e. metal conduit stub-up into a motor control center enclosure or at ground bus bar). Provide an appropriately sized bond jumper from the ground bushing to the respective equipment ground bus or ground bus bar.

g. Each feeder metallic conduit shall be bonded at all discontinuities, including at switchboards and all subdistribution and branch circuit panels with conductors in accordance with Table 250.122 of NEC for parallel return with respective interior grounding conductor.

h. Grounding provisions shall include double locknuts on all heavywall conduits.

i. Install grounding bus in all existing panelboards of remodeled areas, for connection of new grounding conductors, connected to an approved ground point.

j. Bond together reinforcing steel and metal accessories in pool and fountain structures and bond to electrical system per NEC.

k. Where reinforced concrete is utilized for building grounding system, proper reinforced bonding shall be provided to secure low resistance to earth with "thermite" type devices, and #10AWG wire ties shall be provided to not less than ten (10) full length rebars which contact the connected rebar. Provide size and length of rod to meet NEC requirements.

3.16 GROUNDING BAR/GROUND BUS (INCLUDING 'SYSTEMS' GROUND BUS/BAR ON GROUND BUS/BAR) INSTALLATION

a. Where indicated on the drawings, provide grounding bar/ground bus (bus bar). Metal sheaths of underground cables are also to be grounded thereto at points of building entrance.

b. Mount bolt tapping lugs with hex head bolts to bus bar at 2" o.c. spacing, one for each ground conductor.

c. Mount bus bar to wall using 2" polyester molded insulator stand-off.

d. Extend a #2/0 (minimum size) or larger THWN insulated copper ground conductor (if larger size is called for on drawings or required by N.E.C. for service ground, etc.) in PVC conduit to approved service ground installation or ground bus/bar in main service equipment enclosure.

e. Extend #6 insulated copper ground wire from respective bus/bar to each 'local' ground bus/bar in each cabinet for system.

f. 'SYSTEMS' grounding bus/bar must be connected with #2/0 insulated copper conductor to grounding electrodes system as defined in NEC "Article 800-40(b).

3.17 TESTING AND REPORTS

a. Raceway Continuity: Metallic raceway system as a component of the facilities ground system shall be tested for electrical continuity. Resistance to ground throughout the system shall not exceed specified limits.

b. Ground resistance measurements shall be made on each system utilized including:

1. Building structural steel.
2. Driven grounding system.
3. Water pipe grounding system.
4. Other approved systems.

c. Ground resistance measurements shall be made in normally dry weather, not less than 24 hours after rainfall, and with the ground under test isolated from other grounds and equipment. Resistances measured shall not exceed specified limits.

d. Upon completion of testing, the testing conditions and results shall be certified by the Contractor and submitted to the Designer as called for in Section 26 00 90 - Test and Performance Verification.

3.18 INTERFACE WITH OTHER PRODUCTS

a. Interface with site grounding system.

b. Interface with lightning protection system installed under Section 26 41 13.

3.19 FIELD QUALITY CONTROL

a. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

b. Use suitable test instruments to measure resistance to ground of system. Perform testing in accordance with test instrument manufacturer's recommendations using the fall-of-potential method.

END OF SECTION 26 05 26

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SECTION 26 05 29 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

a. Drawings and general provisions of the Contract, including Contractual Conditions and Division 01 Specification sections apply to this section.

1.2 SUMMARY

a. This section includes the requirements for provision and installation of supporting devices.

1.3 DESCRIPTION

a. Furnish and install all supports, anchors, fasteners, hangers and inserts required to mount fixtures, conduit, cables, pullboxes and other equipment furnished under this Division.

1.4 REFERENCES AND REGULATORY REQUIREMENTS

a. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

b. Conform to the requirements of the following:

1. NECA - National Electrical Contractors Association.
2. ANSI/NFPA 70 - National Electrical Code.

1.5 SUBMITTALS

a. Submit catalog cut sheet showing brand of conduit supporting hardware to be used and (where applicable) showing that conduit supporting hardware is UL listed and labeled, and manufactured in the United States.

b. Submit catalog cut sheet on all types of conduit support fittings, hardware, straps, and hangers.

c. Product data shall be submitted for approval on:

1. Mounting hardware and inserts.

2. Conduit straps, hangers and fittings.

3. Supporting channel.

d. Product data shall prove compliance with Contract Documents, National Electric Code, National Board of Fire Underwriters, manufacturer's specifications and written installation data.

e. Submit shop drawing showing routing and location of all conduit racking systems. Provide coordination drawings.

PART 2 - PRODUCTS

2.1 PRODUCT REQUIREMENTS

a. Materials and Finishes: Provide corrosion resistance.

b. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.

PART 3 - EXECUTION

3.1 INSTALLATION

a. Install products in accordance with manufacturer's instructions.

b. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation."

c. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.

d. Do not use spring steel clips and clamps and metal banding straps.

e. Do not fasten supports to sides or bottom of pre-cast structural beams.

f. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

g. Install surface-mounted cabinets and panelboards with minimum of four anchors.

h. In wet and damp locations use stainless steel channel supports to stand cabinets and panelboards one inch (25) mm) off wall.

i. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

j. All items shall be supported from the structural portion of the building, except standard ceiling-mounted lighting fixtures. Small devices may be supported from ceiling system where permitted by ceiling system manufacturer, however, no sagging of the ceiling will be permitted. Wire shall not be used as a support. Boxes and conduit shall not be supported or fastened to ceiling suspension wires or to ceiling channels.

k. Lay out and install work in advance of the laying of floors or walls, and provide all sleeves that may be required for openings through floors, walls, or other assemblies. Where plans call for conduit to be run exposed, provide all inserts and clamps for the supporting of conduit.

l. All conduits shall be securely fastened in place on maximum of 8 foot intervals. Hangers, supports or fastenings shall be provided at each elbow and at the end of each straight run terminating at a box or cabinet. The use of perforated iron for supporting conduits will not be permitted. The required strength of the supporting equipment and size and type of anchors shall be based on the combined weight of conduit, hanger and cables. Horizontal and vertical conduit runs may be supported by one-hole malleable straps, clamp-backs, or other approved devices with suitable bolts, expansion shields (where needed) or beam-clamps for mounting to building structure or special brackets.

m. Where two or more conduits are ran parallel or in a similar direction, they shall be grouped together and supported by means of 1½" x 1½", 12 gauge, pre-galvanized zinc (B-Line or approved substitution), conduit channel trapeze hanger system (racking) consisting of concrete inserts, threaded rods, washers, double nuts for each rod, locknut washers and galvanized "L" angle iron, or Unistrut cross members. Where galvanized "L" angle iron is used, conduits shall be individually fastened to the cross members with malleable iron hangers listed and approved for use on "L" angle iron, bolted with proper size cadmium machine bolts, washers and nuts. Conduits supported to unistrut channel shall be individually fastened with two piece unistrut straps with bolts and nuts listed and approved for such use. Mineralak hangers or one hole type straps fastened to Kindorf racking is not acceptable. Beam clamps shall be malleable iron. All single panelboard, switchboard and motor control center feeder raceway runs shall be supported by means of a trapeze channel hanger support system with provisions for future as specified.

n. All hangers and mounting hardware clamps shall be made of durable material suitable for the application involved. Where excessive corrosive conditions or exterior and damp conditions are encountered, hanger assemblies shall be malleable iron or protected after fabrication by hot dipped galvanizing and where written approval is authorized by the OAR, special paint or other suitable preservative methods may be used.

o. On concrete or brick construction, an electric or hand drill shall be used for drilling holes for all inserts in brick, concrete or similar construction. In brick, inserts shall be near center of brick, not near edge or in joint. Where steel members occur, same shall be drilled and tapped, and round head machine screws shall be used. All screws, bolts and washers used for supporting conduit or outlets shall be fabricated from rust-resisting metal. Self-tapping power

driven fasteners are acceptable on block or brick construction only. Plastic anchors are not acceptable.

p. Spring type conduit clip devices are not acceptable for conduit support.

q. Threaded rod hangers shall be galvanized continuous thread type, minimum 3/8" diameter. Increase size as required to support assembly. Bending of rod hangers is not permitted.

r. Concrete anchors, thread rods, or similar fasteners installed on side or bottom of pre-stressed beams are not acceptable.

s. Group related conduits; support using conduit rack. Construct rack using steel channel in dry locations and galvanized channel or aluminum channel in damp or wet locations (minimum of 24", increase, distance as required for quantity of conduits and spare capacity) provide space on each rack for Building Automation Systems (BAS) raceways and 25 percent additional conduits. Group conduits on channel racking adjacent to each other at one side, allowing all remaining unused space as spare capacity. Spacing between conduits shall not exceed 1" unless written permission is granted by OAR.

t. Each rack shall be provided with minimum of two (2) threaded rod hangers located at the ends of the channel. Increase number of hangers as required to support the assembly.

u. Rack Mounted Equipment: Use channel support system for all rack mounted equipment including all free standing rack mounted equipment. Exterior rack support system to be stainless steel channel. See details on drawings where available. Exterior units shall be thoroughly inspected after installation.

END OF SECTION 26 05 29

SECTION 26 05 33.13 – CONDUIT FOR ELECTRICAL SYSTEMS

PART 1- GENERAL

1.1 RELATED DOCUMENTS

a. Drawings and general provisions of the Contract, including Contractual Conditions and Division 01 Specification sections apply to this section.

1.2 SUMMARY

a. This section includes the requirements for provision and installation of conduit for electrical systems.

1.3 DESCRIPTION

a. Provide and install all equipment, labor, material, accessories, and mounting hardware for a complete and operating system for the following:

1. Rigid Metallic Conduit (RMC)
2. PVC coated Metal Conduit.
3. Flexible metal conduit (FMC)
4. Liquidtight flexible metal conduit (LFMC)
5. Electrical metallic tubing (EMT)
6. Rigid non-metallic conduit (PVC) (RNC)
7. Fittings and conduit bodies.

b. Raceways and conduits shall begin at an acceptable enclosure and terminate only in another such enclosure except conduit/raceway stub-outs.

c. A raceway shall be provided for all electrical power, lighting and electrical systems.

d. Where the Contract Documents refer to the terms "raceway," or "conduit" the materials shall be as listed above in conjunction with NEC article 100, definition of "raceway". MC and HCF flexible metal cables shall not be considered a substitute for raceway or conduit.

1.4 SUBMITTALS

- a. Submit catalog cut sheet showing brand of conduit to be used and showing that conduit is UL listed and labeled, and manufactured in the United States.
- b. Submit catalog cut sheet on all types of conduit bodies, and fittings.
- c. Submit product data on:
 - 1. Conduits.
 - 2. Conduit straps, hangers and fittings.
 - 3. PVC solvent(s) and bending box.
 - 4. Fitting entering and leaving the ground or pavement.
 - 5. Cables
 - 6. Expansion/deflection fittings.
- d. Submit UL listed fire and smoke stopping assemblies for each applicable application. Provide details from UL Fire Directory and manufacturers' corresponding product data and details.
- e. Product data shall prove compliance with Specifications, National Electrical Code, National Board of Fire Underwriters, manufacturer's specifications and written installation data.

1.5 PROJECT AS-BUILT DOCUMENTS

- a. As-built documents shall accurately record actual routing of conduits.

1.6 REFERENCE AND REGULATORY REQUIREMENTS

- a. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.
- b. Conform to the following:
 - 1. NFPA 70 - National Electrical Code (NEC).
 - 2. ANSI C80.1 - Electrical Rigid Steel Conduit (ERSC).

3. ANSI C80.3 - Electrical Metallic Tubing (EMT).
4. ANSI/UL 651 - Rigid Non Metallic Conduit (PVC)
5. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing (EMT) and Cable.
6. NECA "Standard of Installation."
7. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit (IMC).
8. NEMA TC 3 – Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
9. ANSI/Fed. Spec. J-C-30B - Flexible Metal Cables, Galvanized steel jacket.

1.7 DELIVERY, STORAGE, AND HANDLING

- a. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- b. Protect PVC conduit from sunlight.

1.8 PROJECT CONDITIONS

- a. Verify that field measurements are as shown on Drawings.
- b. Verify routing and termination locations of conduit prior to rough-in.
- c. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

PART 2 - PRODUCTS

2.1 GENERAL

- a. All conduits shall bear UL label (or other nationally recognized testing agency).
- b. Conduit systems and all related fittings, boxes, supports, and hangers must meet all the requirements of national, state, requirements and all related FAA codes and other Federal codes where applicable.

2.2 MINIMUM TRADE SIZE

- a. Power/Lighting Homeruns 3/4"
- b. Power/Lighting Branch Circuits Between Devices 1/2"
- c. Systems Conduit 1"
- d. Flexible and Seal-tite metallic conduit – 1/2"C (maximum 6 ft. long).

2.3 RIGID METAL CONDUIT

- a. Comply with:
 - 1. ANSI C80.1
 - 2. UL 6
 - 3. NEC
 - 4. Fed. Specification WW-C-581e.
- b. Conduit material:
 - 1. Hot-dipped galvanized steel.
- c. Fittings:
 - 1. Threaded.
 - 2. Insulated bushings shall be used on all rigid metal conduits terminating in panels, boxes, wire gutters, or cabinets, and shall be impact resistant plastic molded in an irregular shape at the top to provide smooth insulating surface at top and inner edge. Material in these bushings must not melt or support flame.
 - 3. Hot-dipped galvanized malleable iron or steel manufactured in accord with ANSI C80.4.
- d. Conduit Bodies:
 - 1. Comply with ANSI/NEMA FB 1.

2. Threaded hubs.
3. Hot-dipped galvanized malleable iron.

2.4 PVC COATED METAL CONDUIT

- a. Comply with:
 1. UL6
 2. ANSI C80.1
 3. NEC
 4. NEMA RN1
 5. Fed. Specification WW-C-581E.
- b. Conduit material: Hot-dipped galvanized rigid steel with external PVC coating, 20 mil. thick.
- c. Fittings:
 1. Threaded.
 2. Insulated bushings on terminations.
 3. Hot-dipped galvanized malleable iron or steel with external PVC coating, 20 mil. thick.
- d. Conduit bodies:
 1. Comply with:
 - a) ANSI/NEMA FB 1
 - b) Threaded hubs
 - c) Hot-dipped galvanized malleable iron.

2.5 FLEXIBLE METAL CONDUIT

- a. Comply with:
 - 1. NEC
 - 2. ANSI/UL 1
 - 3. Fed. Specification WW-C-566
- b. Conduit material: Hot-dip galvanized Steel, interlocked.
- c. Fittings:
 - 1. ANSI/NEMA FB 1
 - 2. ANSI/UL 514B
 - 3. Malleable iron, zinc plated.
 - 4. Direct flexible conduit bearing set screw type not acceptable.
 - 5. Insulated throat on terminations.
 - 6. Comply also with Fed. Specification W-F-406

2.6 LIQUID-TIGHT FLEXIBLE METAL CONDUIT

- a. Comply with:
 - 1. NEC
 - 2. ANSI/UL 360
- b. Conduit material:
 - 1. Flexible hot-dipped galvanized steel core, interlocked.
 - 2. Continuous copper ground, built into core up to 1-1/4" size.
 - 3. Extruded polyvinyl gray jacket.
- c. Fittings:

1. Threaded for IMC/rigid conduit connections.
2. Approved for hazardous locations where so installed.
3. Provide sealing washer in wet/damp locations.
4. Compression type.
5. ANSI/NEMA FB 1.
6. ANSI/UL 5148.
7. Hot-dipped galvanized malleable iron or steel.
8. Insulated throat on terminations.
9. Comply with Fed. Specification W-F-406.
10. Connections to vibrating equipment and transformers.
 - a) Connectors to have wire mesh conduit grip.

2.7 ELECTRICAL METAL CONDUIT

a. Comply with:

1. U.L 797
2. ANSI C80.3
3. NEC
4. ANSI/UL797
5. Fed. Specification WWC-563

b. Conduit material: Hot-dip Galvanized steel tubing (Electrogalvanized zinc is not acceptable).

c. Fittings:

1. ANSI/NEMA FB 1

2. Compression type.
3. Insulated throat on terminations.
4. Hot-dipped galvanized malleable iron or steel.
5. Fed. Specification W-F-408.

2.8 RIGID NON-METALLIC CONDUIT (PVC)

a. Comply with:

1. NEMA TC-2
2. UL 651
3. NEC
4. Fed. Specification WC1094A.

b. Conduit material:

1. Shall be high impact P.V.C. - tensile strength 55 PSI, flexural strength 11000 PSI.

c. Fittings:

1. Comply with: NEMA TC-3 and UL 514.

d. General:

1. Shall be UL listed.
2. Fittings and elbows shall be by the same manufacture as conduit.

2.9 EXPANSION FITTINGS

a. Expansion/deflection fittings shall be:

1. Listed, hot dipped galvanized inside and outside providing a 4" expansion chamber and deflection (where applicable) when used with rigid conduit, intermediate metal conduit and electrical metallic conduit, or:

2. U.L. Listed, polyvinyl chloride providing a minimum 6" expansion chamber when used with non-metallic conduit (PVC), and shall meet the requirements of and as specified elsewhere for non-metallic conduit. Provide fittings as specified above for expansion/deflection conditions.
3. Hot dipped galvanized expansion and deflection (where applicable) fitting shall be provided with an external braided grounding and bonding jumper with approved clamps, UL Listed for the application.
4. Expansion fitting, UL Listed for the application and in compliance with the National Electrical Code without the necessity of an external bonding jumper may be considered. Submit fitting with manufacturer's data and UL Listing for approval prior to installation.

PART 3 - EXECUTION

3.1 LOCATION REQUIREMENTS

a. Underground Installations:

1. Use Schedule 40 thickwall nonmetallic conduit only unless local authority having jurisdiction or applicable codes/utility requirements, etc. require rigid steel conduit.
2. Encase conduit in a concrete envelope of not less than 3" thickness on all sides and not less than 1-1/2" between conduits (where more than one conduit is installed together) for:
 - a) All conduits installed under roads, taxiways, and runways.
 - b) All conduits installed for primary electric circuits, main feeders, and data/communications systems (i.e. Telephone, data, parking revenue, radio, flight information, air traffic control systems, security, fiber optic).
3. All conduits or elbows entering or leaving any slab or the ground shall be rigid steel conduit coated with asphalt paint.
4. Where rigid metallic conduit is installed underground as noted above it shall be coated with waterproofing black mastic before installation, and all joints shall be re-coated after installation.
5. All PVC runs over 100 ft. in length shall utilize rigid steel 90° elbows at each horizontal change in direction. All PVC risers shall utilize rigid steel 90° elbows. Elbows shall be coated with black mastic or PVC coating. Bond all metal elbows per NEC.

6. Underground raceway systems shall conform to all national, state, local and FAA regulations, in general and Article 300, Section 300.5 of the National Electrical Code specifically.
 - a) Depth of conduits shall be not less than 18" with the following exceptions:
 - 1) Conduits installed in concrete floors of buildings to have a minimum concrete cover not less than 2".
 - 2) Conduits passing under taxiways, runways, ramps, holding areas, and docking areas, must be installed below the concrete pour, in the sub base, and shall be encased in not less than 3" of concrete, the specifications of which shall meet the same standards required for runways and taxiways except that slump shall be 3 to 4 inches.
7. Verify finished lines in areas where raceways will be installed underground before the grading is complete.
 - b. In Slab, Above or On Grade:
 1. Use coated rigid steel conduit, coated intermediate metal conduit (if approved) or thickwall nonmetallic conduit.
 2. In slab conduit is permitted only where written consent is granted by Architect and Structural Engineer, regardless of that shown or noted by drawings. Install as directed by Architect/Structural Engineer.
 - c. Penetration of Slab:
 1. Exposed Location:
 - a) Where penetrating a floor in an exposed location from underground or in slab, a black coated galvanized rigid steel conduit shall be used.
 2. Concealed Location:
 - a) Where penetrating a floor in a location concealed in block wall and acceptable by applicable codes, non-metallic conduit may be used up to first outlet box, provided outlet box is at a maximum height of 40" above finished floor.
 - b) Where penetrating a floor from underground or in slab, a coated galvanized rigid steel conduit shall be used.
 - d. Outdoor Location:

1. Above Grade:
 - a) Where penetrating the finished grade, a coated galvanized rigid steel conduit shall be used.
 - b) All exterior conduit runs shall be rigid conduit and threaded connectors as specified elsewhere.
 - c) All areas subject to exterior conditions such as overhangs, galvanized rigid steel conduit shall be used.
2. Roofs:
 - a) Conduit is not to be installed on roofs.
 - b) When approved by written authorization conduit shall comply with the following:
 - 1) Be PVC coated rigid galvanized metal conduit.
 - 2) All fittings, etc. are to be PVC coated.
 - 3) Conduit shall be supported above roof at least 6 inches using approved conduit supporting devices. Refer to applicable roofing specifications.
 - 4) Fasten supports to roof per roofing manufacturer's recommendations.
3. Cooling Towers:
 - a) Conduit installed at cooling towers shall be PVC coated rigid galvanized conduit.
- e. Interior Dry Locations:
 1. Concealed:
 - a) Use rigid galvanized steel and electrical metallic tubing. Thickwall non-metallic conduit (PVC) may be used inside block walls up to first outlet to a maximum of 40" A.F.F. except where prohibited by the NEC.
 2. Exposed:
 - a) Use rigid galvanized steel and electrical metallic tubing. EMT may only be used where not subject to damage which is interpreted by this specification to be

above 96" AFF and exiting the top of panelboards, terminal cabinets, and control panels.

3. Concealed or exposed flexible conduit:

- a) Concealed:** Flexible steel conduit or seal tight flexible steel conduit shall be in lengths not longer than six (6) feet in length with a ground conductor firmly attached to the terminating fitting at the extreme end of the flex.
- b) Exposed:** Liquid tight flexible steel conduit shall be used for connections to motors, movable equipment, or vibration equipment (transformers, pumps, AHU's, loading bridges, etc.) as specified herein. Lengths shall not exceed four (4) feet in length. Connections to vibration equipment, motors, etc shall be made with wire mesh grip fittings as specified herein. Flexible steel conduit is not acceptable in exposed locations. All exposed flexible metal conduit shall be liquid tight.

f. Interior Wet and Damp Locations:

- 1.** Use rigid galvanized steel in interior wet and damp locations. Areas which are subject to direct exterior conditions such as parking garages and open ramp overhangs shall be classified "WET/EXTERIOR LOCATION."

g. Concrete Columns or Poured in-place Concrete Wall Locations:

- 1.** Use thickwall non-metallic conduit. Penetration shall be by approved metal raceway (i.e. metal conduit as required elsewhere in these specifications).

h. Corrosive Locations:

- 1.** Comply with all codes and standards.

3.2 ADDITIONAL REQUIREMENTS FOR RIGID METAL STEEL CONDUIT

a. Rigid metal conduit shall be cut and threaded with tools approved for the purpose and by qualified personnel.

- 1.** Approved pipe vise.
- 2.** Roller/bade type cutter or band saw.
- 3.** Reamer capable of completely removing al ridges or burrs left by the cutter. Reaming with pliers is not acceptable.

- b.** Hangers shall be installed 8 ft. apart.
- c.** Conduits stubbed through floor slabs, above grade and not contained inside walls, shall be rigid galvanized metallic conduit.
- d.** One hole pipe straps shall be malleable iron. Wet location applications shall include malleable iron back clamp spacers.

3.1 ADDITIONAL REQUIREMENTS FOR INTERMEDIATE METAL CONDUIT (IMC)

- a.** May be installed only by special written permission.
- b.** If written approval is received then IMC may be used in locations acceptable by NEC and elsewhere in these specifications, whichever is most stringent.

3.3 ADDITIONAL REQUIREMENTS FOR FLEXIBLE STEEL CONDUIT AND LIQUID-TITE FLEXIBLE METAL CONDUIT

- a.** Shall be properly grounded.
- b.** Shall be installed with approved fittings.
- c.** Shall be used for final connections to vibrating equipment such as motors, pumps, transformers, etc.
- d.** Liquid-tight conduit termination connectors at vibration equipment (i.e. pumps, AHU's, motors, moveable equipment, etc) shall be provided with wire mesh grips.

3.4 ADDITIONAL REQUIREMENTS FOR NON METALLIC CONDUIT (PVC)

- a.** PVC conduit is not allowed anywhere inside building(s) except underground, in slab, in poured in place concrete, and in block wall up to first outlet box (if not over 40" AFF) if allowed by codes. In elevated slabs, conduit is permitted only where written consent is granted by Structural Engineer, regardless of that shown or noted by drawings. Install as directed by Architect/Structural Engineer.
- b.** Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
- c.** Threads will not be permitted on PVC conduit and fittings, except for rigid steel to PVC couplings.

d. Installation of PVC conduit shall be in accordance with manufacturer's recommendations.

e. PVC conduit shall not be used to support fixture or equipment.

f. Field bends or direction changes shall be by manufactured bends only. Heating with flame and hand held dryers are prohibited.

g. PVC fittings and elbows shall be by same manufacture as conduit.

3.5 ADDITIONAL REQUIREMENTS FOR PVC COATED CONDUIT

a. All cuts, pinholes and ends shall be sealed using liquid PVC patch. PVC coated conduit shall be thoroughly inspected after installation to assure all voids, cuts, pinholes or other violation of the integrity of the PVC coating are sealed.

3.6 SUPPORTS

a. Comply with the requirements of Section 26 05 29 Hangers and Supports for Electrical Systems.

b. Arrange supports to prevent misalignment during wiring installation.

3.7 EXPANSION/DEFLECTION FITTINGS

a. Provide suitable fittings to accommodate expansion and deflection where conduit crosses, control and expansion joints.

b. Expansion fittings shall be installed in the following cases:

1. In each conduit run wherever it crosses an expansion joint in the concrete structure.
2. On one side of joint with its sliding sleeve end flush with joint, and with a length of bonding jumper in expansion/deflection equal to at least three times the normal width of joints.
3. In each conduit run which mechanically attaches to separate structures to relieve strain caused by shift on one structure in relation to the other.
4. In straight conduit run above ground that is more than one hundred feet long and interval between expansion/deflection fittings in such runs shall not be greater than 100 feet.

3.8 GROUNDING

- a. All raceways shall have a copper system ground conductor throughout the entire length of circuit installed within conduit in strict accordance with NEC codes.
- b. Grounding conductor shall be included in total conduit fill determining conduit sizes, even though not included or shown on drawings.
- c. Grounding conductors run with exterior/ underground feeders shall be bare only.
- d. Grounding conductors run with feeders shall be bonded to portions of conduit that are metal by approved ground bushings.
- e. See other sections of these specifications for additional requirements.
- f. Grounding conductors (including lightning protection down conductors) run in metal conduit shall be bonded to metal conduit at both ends.

3.9 CONDUITS PENETRATING 2 HOUR ASSEMBLIES OR GREATER

- a. Conduits with conductors penetrating the wall shall have blow out patches on each side of the wall.
- b. Multiple conduits run through rated walls side by side shall have blow out patches on each side of the wall.
- c. Data or telephone conductors run exposed and penetrating a wall rated 2 hour for fire, smoke or smoke/fire shall be sleeved with steel conduits 30" each side of the wall and conduit ends packed with approved fire sealant.

3.10 FIRE AND SMOKE STOPPING

- a. Contractor is to provide fire stopping and smoke sealing for all penetrations of existing (or new if applicable) fire or smoke assemblies as required to maintain rating of assembly.
- b. All penetrations shall be fire stopped in strict accordance with UL Fire Directory. Submit applicable details for acceptance. Prepare and install as delineated by UL detail(s).
- c. Each penetration shall be identified with the corresponding UL fire assembly number. Labels shall be typed or computer generated minimum 1/2" high black lettering, self-adhesive type.
- d. Comply with UL Fire Directory "F" and "T" ratings respectfully.

3.11 FIRE PROTECTION

a. Emergency life safety feeder-circuit wiring shall be installed either in spaces fully protected by an approved automatic fire suppression system or shall be a listed electrical circuit protection system with a 1-hour fire rating. Fire circuit protection shall be in accordance with UL Fire Protection equipment Directory and UL Building Materials Directory (latest edition).

3.12 VERTICAL RACEWAYS

a. Cables in vertical raceways shall be supported per NEC Article 300.19. Provide supporting devices for cables, including any necessary accessible pull boxes as required regardless if shown on drawings or not. Provide and install access panels as required. Coordinate location of pull box and access panel with designer prior to installation. This includes empty raceways for future use.

3.13 GENERAL

a. Install conduit in accordance with NECA "Standard of Installation." Contractor shall layout all work prior to rough-in.

b. Install nonmetallic conduit in accordance with manufacturer's instructions.

c. Arrange conduit to maintain headroom and present neat appearance.

d. Route conduit installed above accessible ceilings or exposed to view parallel or perpendicular to walls. Do not run from point to point.

e. Route conduit in and under slab from point-to-point.

f. Do not cross conduits in slab.

g. Maintain adequate clearance between conduit and piping.

h. Maintain 12-inch (300-mm) clearance between conduit and surfaces with temperatures exceeding 104 degrees F (40 degrees C).

i. Maintain minimum of 3" inch separation between power and communications raceways. Increase separation if so required to comply with EIA/TIA referenced standards.

j. Systems raceways shall be installed in accordance with ANSI/EIA/TIA Communications Standards.

1. Maintain proper separation between PDS system cables and all power and unshielded cables, as required to prevent noise or crosstalk interference.

2. Raceway bends shall have minimum inside radius of 6 times the internal diameter. Increase bend radius to 10 times for raceway larger than 2 inch size. Provide proper bend for all changes of direction. Pull and splice boxes shall not be used in lieu of a bend.
 3. Install raceways so no more than two 90o bends are in any raceway section without a pullbox. Install additional pull boxes as required to maintain maximum of two 90o bends between pull boxes and termination points.
 4. Install boxes in straight sections of raceway.
- k. Cut conduit square using saw or pipecutter; de-burr cut ends.
 - l. Bring conduit to shoulder of fittings; fasten securely.
 - m. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp locations and to cast boxes. Use threaded conduit hubs to fasten conduit to sheet metal boxes, disconnects switches and equipment control panels in wet and exterior locations.
 - n. Install no more than equivalent of three 90-degree bends between boxes for power and lighting systems. Use conduit bodies to make sharp changes in direction, as around beams, Use appropriate boxes and conduit bodies for fire alarm, voice/data and sound/paging systems. Use factory elbows for bends in metal conduit larger than 2- inch size.
 - o. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
 - p. Provide pull boxes, junction boxes and fire barrier at fire rated walls as required by NEC Article 300, whether shown on drawings or not.
 - q. Provide continuous fiber poly line 1000 lb. minimum tensile strength pull string in each empty conduit except sleeves and nipples. This includes all raceways which do not have furnished conductors. Pull cords must be fastened to prevent accidental removal. A phenolic or brass nameplate shall be attached to each end indicating the location of both ends of conduit as follows: THIS END = "LOCATION," OTHER END = "LOCATION."
 - r. Use suitable seals to protect installed conduit against entrance of dirt and moisture and insects.
 - s. Ground and bond conduit under provisions of Section 26 05 26.
 - t. Identify conduit under provisions of Section 26 05 53.
 - u. Install all conduit concealed from view unless specifically shown otherwise on drawings

- v.** Rigid steel box connections shall be made with double locknuts and bushings.
- w.** All wire raceways shall be kept clear of plumbing fixtures to facilitate future repair or replacement of said plumbing fixtures without disturbing wire raceways. Except where it is necessary for control purposes, all raceways shall be kept away from items producing heat.
- x.** All raceway runs in masonry shall be installed at the same time as the masonry so that no face cutting is required, except to accommodate boxes.
- y.** All raceways shall be run from outlet to outlet as shown on the drawings, unless permission is granted, to alter arrangement shown. If permission is granted arrangement shall be marked on red lined As-Built drawings as previously specified.
- z.** Spare conduit stubs shall be capped and location and use marked with concrete marker set flush with finish grade. Marker shall be 6" round x 6" deep with appropriate symbol embedded into top to indicate use. Also, tag conduits in panels where originating.
- aa.** All conduit stubbed above floor shall be strapped to a metal channel supported by conduit driven into ground or tied to steel. Spare conduit stubs shall be capped with a UL listed and approved cap or plug for the specific intended use and identified with ink markers as to source and labeled "Spare".
- bb.** All connections to motors or other vibrating equipment including transformers or at other locations where required shall be made with not less than 12" nor more than 24" of flexible liquid-tight steel conduit, with nylon insulated throat connectors and wire mesh grip fittings at both terminations of conduit. Use angle connectors wherever necessary to relieve angle strain on flex conduit.
- cc.** Provide a conduit sealing fitting or pliable compound wherever conduit system is exposed to widely temperature changes which may cause condensation within the raceway; as from the inside to the outside of coolers or freezers.
- dd.** Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation specified under other Sections of these specifications.
- ee.** All raceways shall be run in neat and workmanlike manner and shall be properly in accordance with latest edition of NEC with approved conduit clamps, hanger rods and structural fasteners.
- ff.** All raceway runs, whether terminated in boxes or not, shall be capped during the course of construction and until wires are pulled in, and covers are in place. No conductors shall be pulled into raceways until construction work which might damage the raceways has been completed.

gg. Electrical raceways shall be supported independently of all other systems and supports, and shall in every case avoid proximity to other systems which might cause confusion with such systems or might provide a chance of electrolytic actions, contact with live parts or excessive induced heat.

hh. Raceways, boxes, etc shall not be attached to an acoustical grid ceiling system or support wire per NEC Article 300.11. Support all components directly from building structure.

END OF SECTION 26 05 33.13

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SECTION 26 05 33.16 - BOXES FOR ELECTRICAL SYSTEMS

PART 1- GENERAL

1.1 RELATED DOCUMENTS

a. Drawings and general provisions of the Contract, including Contractual Conditions and Division 01 Specification sections apply to this section.

1.2 SUMMARY

a. This section includes the requirements for provision and installation of pull and boxes.

1.3 DESCRIPTION

a. Provide and install all boxes (flush or surface) complete with all accessories as required to facilitate installation of electrical system and as required by the N.E.C.

b. Section includes: Wall and ceiling boxes and junction and pullboxes.

c. Install pull and junction boxes wherever required for a complete and operating distribution system whether shown on drawings or not.

1.4 SUBMITTALS

a. Submit catalog cut sheet/product data on:

1. Surface cast boxes.
2. Covers.
3. Dimensions - inside and out.
4. Rating of concrete or gauge of metal.
5. Manufacturer
6. All boxes to be used on project.

1.5 PROJECT AS-BUILT DOCUMENTS

- a. Record actual locations and mounting heights of pull and junction boxes.

1.6 REFERENCES AND REGULATORY REQUIREMENTS

a. Furnish products listed and classified by Underwriters Laboratories, Inc. and requirements of NEC as suitable for purpose specified and shown.

- b. Conform to the requirements of the following:

1. ANSI/NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.
2. ANSI/NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
3. ANSI/NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports.
4. ANSI/NFPA 70 - National Electrical Code.
5. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.7 PROJECT CONDITIONS

- a. Verify field measurements are as shown on Drawings.
- b. Verify locations of outlets in offices and work areas prior to rough-in.
- c. Verify locations of pull and junction boxes prior to rough-in.
- d. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Install at location required for box to serve intended purpose and to maintain required access.

PART 2 - PRODUCTS

2.1 GENERAL

a. Provide box accessories as required for each installation, including mounting brackets, wallboard hangers, extension rings, boxes, and corrosion-resistant knockout closures compatible with boxes being used and meeting requirements of individual wiring situations.

b. All boxes shall be of the size and shape required by NFPA 70 for their respective locations.

c. Boxes shall be of such form and dimensions as to be adapted to the specific use and location, type of device or fixtures to be used, and number and size of conductors and arrangement, size and number of conduits connecting thereto.

d. Dimensions of pull and junction boxes shall meet dimensions shown on drawings or dimensions required by NEC, whichever is largest.

e. Standard 25 cubic inch pull boxes shall meet the requirements of these specifications for outlet boxes as a minimum.

f. All boxes of 100 cubic inches or more shall be constructed of 14 gauge steel with hot dip galvanized coating.

g. Handy boxes shall not be used.

h. Boxes to be one-piece.

i. 4"x 4" boxes and 4 11/16" x 4 11/16" boxes used as junction boxes shall be one piece.

2.2 SHEET METAL BOXES:

a. ANSI/NEMA OS 1, Galvanized Steel.

b. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch (13 mm) male fixture studs where required.

c. Concrete Ceiling Boxes: For concrete location installation, providing fire resistance rating as required.

d. Interior flush boxes shall be galvanized steel constructed with stamped knockouts in back and sides, and threaded holes with screws for securing box coverplates or wiring devices. T & B, Steel City, Raco or approved substitution.

e. Ceiling boxes shall be 4" octagonal or 4" square X 1 1/2" deep or larger as required for number and size of conductors and arrangement, size and number of conduits terminating at them.

f. Switch, wall receptacle, telephone and other recessed wall boxes in drywall shall be 4" square X 1 1/2" deep. For recessing in exposed masonry, provide one piece 4" square x 1 1/2" deep wall boxes with appropriate 4" square cut tile wall covers Steel City series #52-C-49/52-C-52 or approved substitution. For recessing in furred-out block walls, provide 4" square box with required extension for block depth and required extension for drywall depth.

g. For Communication/Systems Telephone, Data, TV, CCTV, Video, and Computer device boxes shall be 4" square x 2 1/8" deep, minimum. Increase box to 4-11/16" with single gang plaster ring as required for special devices respectfully.

i. Exterior, damp location and wet location pull and junction boxes shall be NEMA 4x stainless steel.

2.3 CAST BOXES:

a. NEMA FB 1

b. Interior surface boxes and conduit bodies installed from 0" AFF to 90" AFF (including fire alarm device backbox) shall be heavy cast aluminum or iron with external threaded hubs for power devices and threaded parts for low voltage devices - Appleton, Crouse Hinds or approved substitution. Trim rings shall also be of one piece construction.

c. Weatherproof boxes shall be constructed of corrosion-resistant cast iron suited to each application and having threaded conduit hubs, cast metal face plate with spring-hinged waterproof cap suitable configured, gasket, and corrosion-proof fasteners.

d. Boxes to be Type FD unless otherwise noted on drawings.

e. Free standing cast boxes are to be type FSY (with flange). Other cast zinc boxes are not acceptable.

2.4 SURFACE-MOUNTED CAST METAL BOX:

a. NEMA 250, Type 4; flat-flanged, surface-mounted junction box.

b. Material: Cast aluminum.

c. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

d. Provide all hubs as required for conduit connections.

PART 3- EXECUTION

3.3 GENERAL

a. Install per NEC.

- b.** Install electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
- c.** Install electrical boxes to maintain headroom and to present neat mechanical appearance.
- d.** Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- e.** Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches (150 mm) from ceiling access panel or from removable recessed luminaire.
- f.** Above ceiling outlet and junction boxes shall be installed to permit readily accessible access from ladder or staging from corresponding floor without the need to extend ladder up through ceiling system to facilitate ease of maintenance.
- g.** Install boxes to preserve fire resistance rating of partitions and other elements.
- h.** Align adjacent wall-mounted boxes for switches, thermostats, and similar devices with each other.
- i.** Outlets for 120V clocks shall be recessed so that the clock will hang flush with the finished surface of the wall.
- j.** Use flush mounting boxes in finished areas.
- k.** Do not install flush mounting boxes back-to-back in walls; provide minimum 6 inch separation. Provide minimum 24 inches (one stud space) separation in acoustic and rated walls.
- l.** Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- m.** Use stamped steel bridges to fasten flush mounting box between studs.
- n.** Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- o.** Lighting control switches shall be located at the latch side of door. If the drawings indicate otherwise, issue a request for clarification prior to rough-in.
- p.** Support all boxes from structure with minimum of one (1) 3/8" all-thread rod hangers. Boxes larger than 25 square inches shall be supported with two (2) all-thread rod hangers, minimum.

- q.** Do not fasten boxes to ceiling support wires.
- r.** Support boxes independently of conduit.
- s.** Pull boxes shall be installed in straight runs of conduit only. Pull boxes shall not be used in place of a conduit bend.
- t.** Use gang box where more than one device is mounted together. Do not use sectional box.
- u.** Use gang box with plaster ring for single device outlets.
- v.** Comply with applicable portions of the National Electrical Contractor's Association's (NECA) "Standard of Installation".
- w.** Install outlets in the locations shown on the drawings.
- x.** Coordinate each electrical box so that the type is suitable for the wall or ceiling construction anticipated and suitable fireproofing is built into fire rated assemblies.
- y.** Relocate electrical boxes as required so that electrical devices, once installed, will be symmetrically located with respect to the room layout.
- z.** All boxes shall be installed in a flush rigid manner with box lines at perpendicular and parallel angles to finished surfaces. Boxes shall be supported by appropriate hardware selected for the type of surface from which the box shall be supported. For example, provide metal screws for metal, wood screws for wood, and expansion devices for masonry or concrete.
- aa.** For damp and wet locations provide weatherproof boxes and accessories.
- bb.** As a minimum, provide pull boxes in all raceways over 150 feet long. The pull box shall be located near the midpoint of the raceway length.
- cc.** Provide knockout closures to cap unused knockout holes where blanks have been removed, and plugs for unused threaded hubs.
- dd.** Provide conduit locknuts and bushings of the type and size to suit each respective use and installation.
- ee.** Boxes and conduit bodies shall be located so that all electrical wiring is accessible.
- ff.** Avoid using round boxes where conduit must enter box through side of box which would result in a difficult and insecure connection with a locknut or bushing on the rounded surface.

gg. All flush outlets shall be mounted so that covers and plates will finish flush with finished surfaces without the use of shims, mats or other devices not submitted or approved for the purpose. Add-a-Depth rings or switch box extension rings (Steel City #SBEX) are not acceptable. Plates shall not support wiring devices. Gang switches with common plate where two or more are indicated in the same location. Wall-mounted devices of different systems (switches, thermostats, etc.) shall be coordinated for symmetry when located near each other on the same wall. Outlets on each side of walls shall have separate boxes. Through-wall type boxes shall not be permitted. Back-to-back mounting shall not be permitted. Trim rings shall be extended to within 1/8" of finish wall surface.

hh. Boxes mounted in metal stud walls, are to be supported to studs with minimum of two (2) self-tapping screws inside, at the back of box, to a horizontal stud brace between vertical studs or pre-manufactured heavy duty box bracket equal to Caddy Corporation # SGB/TSGB series, to prevent movement of box after wall is finished.

ii. All boxes that do not receive devices in this contract are to have blank plates installed matching wiring device plates.

jj. Mount Height.

1. Height of wall outlets to bottom above finished floors shall be as follows, unless specifically noted otherwise, or unless otherwise required by applicable codes including ADA. Verify with the Architectural plans and shop drawings.
 - a) Switches: 4'-0" AFF to top
 - b) Receptacles: 1'-4" AFF to bottom
 - c) Lighting Panels: 6'-6" AFF maximum to centerline of highest breaker/fuse
 - d) Phone Outlets: 1'-4" AFF to bottom
 - e) ADA Wall Phones: (See part 3.1, Item HH.(4.) below)
 - f) Fire Alarm Pull Stations: 4'-0" AFF to top
 - g) Fire Alarm Strobe Lights: 80" AFF to bottom of globe or 6" below ceiling to top, whichever is lower
2. Bottoms of outlets and switches above counter tops or base cabinets shall be minimum 2" above counter top or backsplash, whichever is highest. Outlets and switches may be raised so that bottom rests on top of concrete block course, but all outlets above counters in same area shall be at the same height. Coordinate outlet locations in relation to all casework shown on Architectural plans, prior to rough-in, regardless of height shown on Electrical drawings.

3. Height of wall-mounted fixtures shall be as shown on the drawings. Fixture boxes shall be equipped with fixture studs when supporting fixtures.
4. Coordinate locations and mounting heights of boxes for all phones with architect, phone system installer and approved shop drawings prior to rough-in. Install as directed, including requirements of ADA. In general, ADA wall phones shall be at a maximum of 54" to highest operable part essential to basic operation of telephone with side reach and maximum of 48" forward reach as defined by 3.1 HH.1.

kk. Special Purpose Outlets.

1. Locate special purpose outlets as indicated on the drawings for the equipment served. Location and type of outlets shall be coordinated with appropriate trades involved. Coordinate roughing-in locations. Provide plug for each outlet.

ll. Outlets in Rated Assemblies and Smoke Barriers.

1. Metallic and approved non-metallic electrical boxes may be installed in vertical fire resistive assemblies or smoke barriers without affecting the classification, provided such openings occur on one side only in each framing space and that openings do not exceed 16 sq. inches.
2. All clearances between such boxes and the gypsum board must be completely filled with joint compound or other approved materials.
3. The wall must be built around outlets of larger size so as not to interfere with the integrity of the wall rating.

3.4 INTERFACE WITH OTHER PRODUCTS

- a. Coordinate installation of box for products furnished under all Sections of these specifications.
- b. Coordinate locations and sizes of required access doors with applicable sections in these specifications.
- c. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- d. Coordinate mounting heights and locations of outlets mounted above counters, benches and backsplashes.
- e. Position boxes to locate luminaires as shown on reflected ceiling plan.

3.5 ADJUSTING

- a.** Adjust flush-mounting outlets to make front flush with finished wall material.
- b.** Install knockout closure in unused box opening.
- c.** Install pull and junction boxes as shown on drawings or as required by the National Electric Code (NEC). Identification of boxes is required. Phenolic labels or permanent marks with voltage, circuit, panel, fed from, location of source, location of load.
- d.** Pull and junction boxes (not in-ground type) used for systems larger than 25 square inches shall be hinged cover type with flush latches operated with screwdriver.
- e.** Pull and junction boxes larger than 25 square inches shall be supported with (2) all-thread rod hangers minimum. Increase quantity and size of all-thread rod hangers as required for application, and to eliminate movement and swaying.

END OF SECTION 26 05 33.16

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SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1- GENERAL

1.1 RELATED DOCUMENTS

a. Drawings and general provisions of the Contract, including Contractual Conditions and Division 01 Specification sections apply to this section.

1.2 SUMMARY

a. This section includes the requirements for provision and installation of identification for electrical equipment.

1.3 DESCRIPTION

a. Provide and install all equipment, labor and material for a complete identification system, including but not limited to:

1. Nameplates and labels.
2. Wire and cable markers.
3. Conduit markers.
4. Identify all new and existing conduits, boxes, equipment, etc. as specified herein.

1.4 REFERENCES AND REGULATORY REQUIREMENTS

a. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

b. Conform to the requirements of the following:

1. ANSI/NFPA 70 - National Electrical Code.
2. Americans with Disabilities Act - 1990.

PART 2 - PRODUCTS

2.1 NAMEPLATES

a. Nameplates for Normal Branch Power shall be laminated black phenolic plastic with chamfered edges and white engraved lettering.

b. Letter Size:

1. 1/8 inch for identifying individual equipment and loads.
2. 1/4 inch for identifying grouped equipment and loads.

c. Nameplates shall adequately describe the function of the particular equipment involved. Where nameplates are detailed on the drawings, inscription and size of letters shall be as shown and shop drawing submitted for approval. Nameplates for panelboards and switchboards shall include the panel designation, voltage and phase of the supply. For example, "Panel A, 120/208V, 3-phase, 4-wire". In addition, provide phenolic label in panel to describe where the panel is fed from. For example, "Fed From MDP-1:3:5". The name of the machine on the nameplates for a particular machine shall be the same as the one used on all motor starters, disconnect and P.B. station nameplates for that machine.

d. The following items shall be equipped with nameplates: All motors, motor starters, motor-control centers, push-button stations, control panels, time switches, disconnect switches, transformers, panelboards, circuit breakers (i.e., all 2 pole, 3 pole C.B.'s), contactors or relays in separate enclosures, power receptacles where the nominal voltage between any pair of contacts is greater than 150V, wall switches controlling outlets that are not located within sight of the controlling switch, high voltage boxes and cabinets, large electrical, and electrical systems junction and pull boxes (larger than 4 11/16"), terminal cabinets, terminal boards, and equipment racks. Nameplates shall also describe the associated panel and circuit number (if applicable).

e. All receptacles shall be clearly labeled with panel/circuit designation.

f. All junction/pull boxes shall receive phenolic labels clearly labeling circuitry/cabling/etc., within.

2.2 WIRE MARKERS

a. Description: Cloth, tape, split sleeve, or tubing type wire markers.

b. Locations: Each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.

c. Legend:

1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings including neutral conductor.

2. Low voltage circuits (circuits under 120V):

d. Control wire number indicated on schematic and interconnection diagrams on shop drawings.

2.3 CONDUIT/JUNCTION BOX COLOR CODE

a. All conduit system junction boxes (except those subject to view in public areas) shall be color coded as listed below:

Fire Alarm	Popsicle Orange K02410
Normal Power 277/480 Volt	Leather Brown K02501
Normal Power 120/208 Volt	Glossy Black K01601

b. Utilize conduit banding tape. Surface of conduits shall be thoroughly cleaned prior to tape application, and tape shall be applied in a neat and workmanlike manner. Tape to be manufactured by Seton Identification Products only.

2.4 CONDUIT/JUNCTION BOX MARKER

a. All new and existing junction boxes/cover plates for power, lighting and systems (except those installed in public areas) shall adequately identify its associated systems panel and circuit number. Identification shall be by means of black permanent marker. (Paint one-half cover plate with appropriate color above, and one-half with associated panel/circuit or system as described above.)

2.5 DEVICE COVER PLATE IDENTIFICATION

a. Description: Self-adhesive clear printed labels with Black typed letters (pre-printed, dot matrix, or laser).

b. Locations:

1. Each new receptacle cover plate.
2. Each existing receptacle cover plate in areas of remodel/renovation.

c. Legend:

1. Receptacle plates shall adequately describe its associated panelboard and circuit reference.
2. System plates shall adequately describe its terminal board, or terminal cabinet, termination cable identifier and assigned user code number.

2.6 UNDERGROUND WARNING TAPE

a. Description: 6 inch wide plastic tape, detectable type, colored red with suitable warning legend describing buried electrical lines, one strip per 24" of duct.

PART 3 - EXECUTION

3.1 PREPARATION

a. Degrease and clean surfaces to receive nameplates and labels.

3.2 APPLICATION

- a. Install nameplate parallel to equipment lines.
- b. Secure nameplate to equipment front using stainless steel pop rivets.
- c. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.

d. Nameplates installed inside on dead front cover shall be self adhesive tape. (Do not drill or install screws in dead front.)

e. Identify new and existing conduit, junction boxes, and outlet boxes using field painting.

f. Identify new underground conduits using underground warning tape. Install one tape per 24 inches of trench at 3 inches below finished grade.

g. Install wire markers at all new and existing connections and terminations.

END OF SECTION 26 05 53

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

a. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

a. This Section includes the following lighting control devices:

1. Wall Occupancy Sensor
2. 24VDC Power Pack
3. Low Voltage Wall Switches
4. Outdoor photoelectric switches.
5. Ceiling occupancy sensors.
6. Lighting contactors.
7. Emergency shunt relays.

b. Related Sections include the following:

1. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.3 SEQUENCE OF OPERATION

a. Electrical, mechanical, machine, communications will all be on standard switches that will not turn off automatically due to the life safety hazard that automatic control would create.

b. Janitor room will be on a standard occupancy sensor with manual on operation required. This will turn off within 30 minutes of no motion.

c. Individual restrooms will be on motion sensor wall switch control.

d. Offices will be on motion sensor vacancy controls. Light to be turned off/on via low voltage switch. If occupancy not detected during 20 minute delay, lights to shut off.

1.4 DEFINITIONS

a. LED: Light-emitting diode.

b. PIR: Passive infrared.

1.5 SUBMITTALS

a. Product Data: Include dimensions and data on features, components, options, NRTL listings, wiring diagrams, and electrical ratings for each type of product to be utilized.

b. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Interconnection diagrams showing field-installed wiring.
- c. Field quality-control test reports.
- d. Operation and Maintenance Data: For each type of product to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.7 COORDINATION

- a. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.
- b. Coordinate features of devices specified in this Section with systems and components specified in other Sections to form an integrated system of compatible components. Match components and interconnections for optimum performance of specified functions

1.8 SPECIAL WARRANTIES

- a. Occupancy Sensors shall be provided with a 5 year extended warranty.

PART 2 - PRODUCTS

2.1 OUTDOOR PHOTOELECTRIC SWITCHES

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the
 1. Intermatic, Inc.
 2. TORK.
- b. Description: Solid state, with SPST dry contacts rated for 2000-W tungsten or 1800VA ballast, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.
 1. Light-Level Monitoring Range: 1.5 to 15 fc (16.14 to 162 lx), with an adjustment for turn-on and turn-off levels within that range, and a sliding light level selector in front of photocell to prevent fixed light sources from causing turn-off.
 2. Time Delay: Up to 2 minutes to prevent false operation.
 3. Mounting: ½" conduit or box mounting as required to direct sensor to the north sky exposure.
 4. Temperature Range: -40 Deg F to +140 Deg F (-40 Deg C to +60 Deg C)

5. Heavy-duty die cast zinc, gasket for maximum weather protection.

2.2 POWER PACKS

- a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- b. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes. Set time delay to 30 minutes.
- c. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit. Up to 14 sensors may control 1 relay unit.
- d. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70 for up to 14 sensors.
- e. Mounting:
 1. Sensor: Suitable for mounting in any position on a standard outlet box.
 2. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
- f. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
- g. Design Selection:
 1. Legrand Watt Stopper BZ-150
 2. Acuity nLight nPP16

2.3 CELING MOUNTED LOW VOLTAGE OCCUPANCY SENSORS

- a. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
- b. Bypass Switch: Override the on function in case of sensor failure or fail safe in the on position.
- c. Sensor: 360 deg passive infrared (PIR) detector (up to 1200sf) to turn lights on and off based on occupancy, isolation relay and light level sensor . Particular technology that controls on-off functions shall be selectable in the field by operating controls on unit.
- d. Accepts low-voltage switch input for manual-on operation
- e. Sensitivity Adjustment: PIR high to low.
- f. Detection Coverage (Standard Room): Detect occupancy anywhere within area of installation at a minimum. See drawings for type of detector to be utilized.
- g. Design Selection:
 1. Wattstopper CI-300
 2. Acuity nCM

2.4 WALL MOUNT OCCUPANCY SENSOR

1. Operation: Unless otherwise indicated, turn lights on manually and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes. Set switches for manual on and 30 minute delay to off in unoccupied state.
2. Mounting:
 - a) Sensor: Suitable for mounting in a standard outlet box.
 - b) Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
3. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
4. Bypass Switch: Override the on function in case of sensor failure or fail safe in the on position.
5. Sensor: Dual-Technology Type, wall mounting; detect occupancy by using a of PIR detection and retain detection with microphonic or ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.
6. Sensitivity Adjustment: Separate for each sensing technology.
7. Detection Coverage (Standard Room): Detect occupancy anywhere within area of installation at a minimum. See drawings for type of detector to be utilized.
8. Design selection:
 - a) Wattstopper DW-100 or equal
 - b) Acuity LWS Series

2.5 LIGHTING CONTACTORS

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Allen-Bradley; a division of Rockwell Automation.
 2. Eaton Electrical Inc.; Cutler-Hammer Products.
 3. Square D; Schneider Electric.
- b. Description: Electrically operated and mechanically held complying with NEMA ICS 2 and UL 508.
 1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current). Provide 20A minimum rating for all contacts.

2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure or as specified.
5. Control Coil Voltage: Match control power source.
6. When multiple contactors are installed with a single enclosure, the assembly shall be UL 508A listed as a control assembly.

2.6 EMERGENCY SWITCHING RELAY

a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. LVS Controls Inc

b. Description: Automatically connects emergency loads upon utility power interruption regardless of switch position and switches lights with the normal lighting switch under normal conditions (no emergency lighting switch is required). Device shall be UL 924 listed and 20A rated contacts. Coil Rating: 120 or 277 V.

c. Include an automatic diagnostic which is initiated when the room switch is turned off. This test procedure will turn the emergency luminaires on for at least 2 seconds, indicating that an emergency power source is available & that the device, ballast, & lamp are all functioning correctly. Automatic diagnostic shall be approved to meet periodic testing requirements (NEC 700.3 NFPA 101 7.9.3

d. Unit shall have regular power indicator LED indicating utility power status.

e. Unit accepts separate phases on the constant hot & switched hot inputs.

f. 5 year manufacturer's warranty

g. Basis of design is LVS – EPC-A-1

2.7 CONDUCTORS AND CABLES

a. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

b. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

- a. Install equipment level and plumb and according to manufacturer's written instructions.
- b. Mount lighting control devices according to manufacturer's written instructions and requirements in Division 26 Section "Basic Electrical Materials and Methods."
- c. Mounting heights indicated are to bottom of unit for suspended devices and to center of unit for wall-mounting devices.
- d. Connections: Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A
- e. Bundle, train, and support wiring in enclosures.
- f. Ground equipment.

3.2 SENSOR INSTALLATION

- a. Install and aim sensors in locations to achieve not less than 95 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
- b. Install in accordance with manufacturers recommendations, which shall determine final sensor location. All sensors shall have non-adjustable factory calibrated sensitivity for maximum performance. Set all time delays for 30 min to avoid nuisance turn off's.

3.3 CONTACTOR INSTALLATION

- a. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.4 WIRING INSTALLATION

- a. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- b. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- c. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in terminal cabinets; and equipment enclosures.

3.5 IDENTIFICATION

- a. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.

2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.
 - b. Label time switches and contactors with a unique designation.
 - c. Provide warning labels on all equipment with more than one source of power located within the enclosure in accordance with Division 26 Section "Identification for Electrical Systems".

3.6 FIELD QUALITY CONTROL

- a. Perform the following field tests and inspections and prepare test reports:
 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

3.7 ADJUSTING

- a. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.8 DEMONSTRATION

- a. Demonstrate products specified in this Section to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 26 09 23

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SECTION 26 22 00 – LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

a. Drawings and general provisions of the Contract, including Contractual Conditions and Division 01 Specification sections apply to this section.

1.2 SUMMARY

a. This section includes the requirements for provision and installation of low-voltage transformers.

1.3 DESCRIPTION

a. Provide and install all equipment, labor, material, accessories, and mounting hardware for a complete and operating system for low-voltage transformers.

1.4 SUBMITTALS

a. Product Data: Provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, KVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.

1.5 QUALIFICATIONS

a. Manufacturer: Same as for products specified in Section 26 24 16 Panelboards.

1.6 REFERENCES AND REGULATORY REQUIREMENTS

- a. Furnish products listed and tested by UL as suitable for purpose specified and shown.
- b. Conform to requirements of the following:
 - 1. ANSI/NFPA 70 - National Electrical Code.
 - 2. NECA - Standard of Installation.
 - 3. NEMA ST 1 - Specialty Transformers.
 - 4. NEMA ST 20 - Dry Type Transformers for General Applications.

1.7 DELIVERY, STORAGE, AND HANDLING

- a. Store, protect, and handle products per manufacturer's recommendations.
- b. Deliver transformers individually wrapped for protection and mounted on shipping skids.
- c. Accept transformers on site. Inspect for damage.

d. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

e. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to internal components, enclosure, and finish.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- a.** Eaton
- b.** Square D
- c.** Siemens.

2.2 TWO-WINDING TRANSFORMERS

- a.** Description:
 - 1.** NEM2A ST 20, factory-assembled, air cooled dry type transformers, ratings as indicated.
 - 2.** Other Non-Linear load transformers shall be as scheduled and noted on drawing.
 - 3.** Isolation and shielded type transformers (if applicable) shall be as scheduled and noted on drawings.
- b.** Insulation system and average winding temperature rise for rated KVA as follows:
 - 1.** 1-15 KVA: Class 185 with 115 degrees C rise.
 - 2.** 16-500 KVA: Class 220 with 115 degrees C rise.
- c.** Case temperature: Do not exceed 35 degrees C rise above ambient at warmest point.
- d.** Winding Taps:
 - 1.** Transformers Less than 15 KVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
 - 2.** Transformers 15 KVA and Larger: NEMA ST 20.
- e.** Sound Levels: NEMA ST 20.
- f.** Basic Impulse Level: 10 KV.13
- g.** Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

h. Mounting: Suitable for wall, floor, or trapeze mounting, except transformers larger than 30 KVA, suitable for floor or trapeze mounting.

i. Coil Conductors: Continuous windings with terminations brazed or welded.

j. Transformer windings shall be continuous wound copper (98% conductivity) construction.

k. Enclosure: NEMA ST 20; Type 1 or Type 3R ventilated as indicated. Provide lifting eyes or brackets.

l. Isolate core and coil from enclosure using vibration-absorbing mounts.

m. Nameplate: Include transformer connection data.

n. Lugs: Suitable for terminating conductors sized for full load ampacity of transformer unit. Transformer lugs and mounting hardware shall be furnished by Manufacturer of transformer and shall be grade 5 with beveled washers. Hardware shall be of suitable size of pad opening per NEMA Standards.

2.3 SOURCE QUALITY CONTROL

a. Provide production testing of each unit in accordance with NEMA ST 20.

PART 3 - EXECUTION

3.1 EXAMINATION

a. Verify site condition. Do not install NEMA 1 equipment until building has reached the "dried-in" stage.

b. Verify that surfaces are suitable for installing transformer supports.

3.2 PREPARATION

a. Concrete Pad: Design per manufacturer's requirements plus three inches on all sides.

3.3 INSTALLATION

a. Install Products in accordance with manufacturer's instructions.

b. Set transformer plumb and level.

c. Maintain clearances around enclosure for ventilation in accordance with manufacturer's instructions.

d. Use flexible conduit, under the provisions of Section 26 05 33, one foot minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

e. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.

f. Provide grounding and bonding in accordance with Section 26 05 26.

g. Ground per NEC 250-26 and to meet local codes as applicable. Grounding lugs shall be multi-conductor type UL Listed for quantity and size of conductors terminated.

h. Wall Mounted Transformers: Wall brackets shall be securely attached to concrete or masonry construction only and have supplemental support by means of all-thread rod hangers from superstructure above. Wall mounted transformers at non structural walls shall be supported from superstructure above with all-thread rod hangers, angle iron channel site manufactured structural stand, or combination thereof.

1. Installation of wall mounted transformers shall be installed to maintain clear space about/above panels as defined by NEC.

i. Conduit or piping systems that contain water or liquid of any kind shall not be installed over the top of any electrical equipment, transformers, racks, cabinets, or enclosures without prior written approval from the Owner.

3.4 FIELD QUALITY CONTROL

a. Install field inspect and test per manufacturer recommendations prior to energizing.

b. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION 26 22 00

SECTION 26 24 16 - PANELBOARDS

PART 1- GENERAL

1.1 RELATED DOCUMENTS

a. Drawings and general provisions of the Contract, including Contractual Conditions and Division 01 Specification sections apply to this section.

1.2 SUMMARY

a. This section includes the requirements for provision and installation of panelboards.

1.3 DESCRIPTION

a. Provide all labor, materials, and equipment necessary to properly and completely install panelboards as scheduled on the drawings and as required by this section.

1.4 SUBMITTALS

a. Submit product data on each basic panelboard construction type, showing manufacturer's standard construction data including:

1. Cabinet construction/dimensions.
2. Bus construction.
3. UL labeling.
4. Each overcurrent device.

b. Shop drawings shall be submitted for each panel and clearly indicate the following information:

1. Label.
2. Each circuit breaker amperage rating, circuit number and position/location in panel.
3. Electrical characteristics of panel.
4. Mains rating.
5. Main device rating.
6. Mounting.
7. Dimension, width, depth, height.
8. Bus material.
9. Interrupting capacity of minimum rated breaker.

10. Panel type.

1.5 PROJECT AS-BUILT DOCUMENTS

a. Record actual locations of Panelboards on red lined as-built documents and indicate actual branch circuit arrangement.

1.6 OPERATION AND MAINTENANCE DATA

a. Provide spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.7 QUALITY ASSURANCE

a. Manufacturer: Company specializing in manufacturing products specified for minimum ten years.

1.8 REFERENCES AND REGULATORY REQUIREMENTS

a. Furnish products listed and classified by UL as suitable for purpose specified and indicated.

b. Conform to the requirements of the following:

1. ANSI/NFPA 70 - National Electrical Code.
2. NECA (National Electrical Contractors Association) - "Standard of Installation."
3. NEMA AB 1 - Molded Case Circuit Breakers.
4. NEMA PB 1 - Panelboards.
5. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
6. UL 67 - Panelboards
7. UL 50 - Cabinets and Boxes
8. Fed. Spec. W-P-115C

1.9 FIELD MEASUREMENTS

a. Verify that field measurements are as instructed by manufacturer.

1.10 DELIVERY, STORAGE AND HANDLING

- a. Handle panelboards and enclosures carefully to prevent damage.
- b. Store equipment indoors and protect from weather.

c. Deliver tubs and internal assemblies sufficiently in advance of installation period as necessary to prevent delay of work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- a. Eaton
- b. Square D
- c. Siemens.

2.2 GENERAL

a. Lighting and Appliance Branch Circuit Panelboards: NEMA PB1, circuit breaker type, dead front, UL 67.

b. Panelboard Bus: Copper ratings as indicated. Provide copper ground bus in each panelboard. Provide isolated full size neutral bus where neutral is applicable.

c. Short-Circuit Rating:

1. Minimum short circuit interrupting capacity: 10,000 amperes rms symmetrical for 240 volt panelboards; 14,000 amperes rms symmetrical for 480 volt panelboards. Bus shall be braced for minimum capacity equal to or greater than the lowest breaker symmetrical interrupting capacity. Minimum short circuit rating shall be increased to meet the following requirements:
 - a) Individual C.B. AIC Rating shown on panel schedules indicate lowest AIC rating allowed for individual circuit breaker in panel.
 - b) Circuit breakers shall be based on a fully rated system.
 - c) Circuit breaker types are not specified. Provide breakers to comply with the required AIC specified.

d. Enclosure:

1. Enclosures shall be at least 20 inches wide made from galvanized steel. Provide minimum gutter space in accordance with the National Electrical Code. Where feeder cables supplying the mains of a panel are carried through its box to supply other electrical equipment, the box shall be sized to include the additional required wiring space. At least four interior mounting studs with adjustable nuts shall be provided.
2. Enclosures shall be provided with blank ends.
3. Where indicated on the drawings, branch circuit panelboards shall be column width type.

4. Regulatory Requirements:
 - a) NEMA PB 1, Type 1, Interior dry locations.
 - b) NEMA PB 1, Type 3R, Interior damp locations.
 - c) NEMA PB 1, Type 4X stainless steel watertight, Exterior locations including those noted on drawings to be NEMA 3R.
 - d) NEMA PB 1, Type 4X stainless steel watertight, interior wet locations, and wash-down areas, regardless of that noted on drawings.
 - e) UL 50
- e. Cabinet box:
 1. 6 inches (153 mm) deep; width: 20 inches (508 mm), minimum.
 2. Interior dry and damp locations shall be constructed of galvanized code gauge steel, to prevent rust.
 3. Exterior, wash-down areas, and Interior wet locations shall be constructed of type 4X stainless steel, watertight.
- f. Cabinet Front:
 1. Flush or surface with concealed trim clamps, concealed hinge, and flush lock all keyed alike.
 2. Shall be door-in-door construction.
 3. Finish in manufacturer's standard baked enamel finish for interior dry locations. Interior damp location panels to be painted with rust inhibit primer epoxy paint top coat system.
 4. Exterior, wash-down areas, and Interior wet locations shall be constructed of type 4X stainless steel, watertight.
- g. Panels and breakers shall be rated for voltage and class of service to which applied.
- h. Spaces:
 1. Space provisions or spaces for future breakers shall be located at the bottom of the panel and be fully bussed complete with all necessary mounting hardware less the breaker.

2.3 MAINS

- a. Provide main lug only (MLO) or main circuit breaker (MCB) as noted on drawings either by riser diagram or by schedule. Where conflict exists, provide MCB.

- b.** Regardless of what is shown on drawings provide the following minimum requirements.
 - 1. Main circuit breaker on each panel serving building main if required by applicable codes.
 - 2. Main circuit breaker on each panel fed directly from a transformer (unless disconnect with overcurrent devices is installed in feeder between transformer and panel).
- c.** Provide lugs as required for conductors being connected to panelboard lugs, circuit breakers, etc.
- d.** Main circuit breaker is not to be mounted as branch breaker or subfeed breaker.

2.4 CIRCUIT BREAKERS

a. General

- 1. Molded Case Circuit Breakers: NEMA AB 1, plug-on type for 250V or less, bolt-on type for over 250V, thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers.
- 2. Current Limiting Molded Case Circuit Breakers: NEMA AB 1. Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole.

b. Main Breakers:

- 1. Main breakers shall be individually mounted separate from branch breakers.
- 2. Covered by a metal plate, except for operating handle.
- 3. Connection from the load's side to the panel bus shall be bus bar. Insulated wire not permitted.

c. Branch Breakers:

- 1. Thermal-magnetic, molded case, with inverse time-current overload and instantaneous magnetic tripping, unless otherwise shown. Breakers shall be calibrated for 40 degrees C or shall be ambient compensating.
- 2. Quick-make, quick-break, with tripped indication clearly shown by breaker handle taking a position between ON and OFF.
- 3. Multi-pole breakers shall have common internal trip. No handle ties between single pole breakers are acceptable for this Project.
- 4. Single pole 15 and 20 ampere circuit breakers shall be rated for switching duty and shall be labeled as "SWD".

5. Rating shall be as called for under "2.2 GENERAL".
6. Ground Fault Circuit Interrupters (GFI):
 - a) Provide UL Class (5 milliamp sensitivity) ground fault circuit protection on 120 VAC branch circuits for exterior location receptacles and for interior locations where required by NEC. (These may not be indicated on Panel Schedule.) This protection shall be an integral part of the branch circuit breaker which also provides overload and short circuit protection for branch circuit wiring. Tripping of a branch circuit breaker containing ground fault circuit interruption shall not disturb the feeder circuit to the panelboard. Provide separate neutral for circuits on GFI breakers whether indicated on drawings or otherwise.
7. Breakers feeding heating and air conditioning equipment shall be rated HACR type breaker.

2.5 SERVICE ENTRANCE EQUIPMENT

- a. Panelboards used as service entrance equipment shall be listed and labeled by UL for use as service equipment.

PART 3 - EXECUTION

3.1 PREPARATION/INSPECTION/EXAMINATION

- a. Verify that surface is suitable for panelboard installation. Do not install NEMA 1 equipment until building has reached the "dried-in" stage.
- b. Examine area to receive panelboard to assure adequate clearance for panelboard installation.
- c. Verify prior to installation that National Electrical Code clearances will be maintained after installation. Rework equipment locations as required to provide electrical code clearances.
- d. Start Work only after unsatisfactory conditions are corrected.
- e. Submit coordination drawings of all electrical rooms, showing all equipment. Comply with Section 26 00 10 Basic Electrical Requirements.

3.2 INSTALLATION

- a. Install panelboards in accordance with NEMA PB 1.1. Install all panelboards and panelboard enclosures in accordance with the manufacturer's written instructions, NECA's "Standard of Installation", the applicable requirements of the National Electrical Code, and recognized industry practices.
- b. Install panelboards plumb. Install recessed panelboards flush with wall finishes. Provide supports in accordance with Section 26 05 29 Supporting Devices.
- c. Panelboards shall be provided with structural framing located within gypsum board partitions. All enclosures shall be firmly anchored to walls and supporting structures (where

used) using appropriate hardware. Provide supporting channels on walls constructed of gypsum board or where otherwise necessary to provide a mechanically secure and permanent installation. Attach channels to framing provided within gypsum board partitions.

d. Enclosures shall be installed so that the top is 6'-6" above finished floor.

1. Where the size of the enclosure is such that the top cannot be installed at 6'-6", the top of the enclosure shall be kept as low as possible.

e. Panelboard backboxes/trim covers mounted adjacent to each other (i.e. multi-section panels, etc) installed in finished areas be of same size.

f. Provide filler plates for unused spaces in panelboards.

g. Provide typed circuit directory from panelboard manufacturers' original card stock, for each branch circuit panelboard. Mount a typewritten directory showing the actual circuit numbers, type of load and room names on inside of door. Room names shall be actual names or numbers used, not necessarily shown on the drawings. Progress Drawings shall show same arrangements as the Directory. Revise directory to reflect circuiting changes required to balance phase loads.

h. Provide four each 1 inch spare conduits out of each recessed panelboard to an accessible location above ceiling. Identify each as SPARE.

i. Clean the interior of each panelboard before installing conductors. At all times, keep the interior trim and exterior surfaces of the panelboard free of rust and debris. Repaint finishes if necessary.

j. Coordinate all raceways and conductors with their respective panelboards so that all connections and conductors routing present an orderly appearance. Conductors in the panelboards shall be neatly laced and arranged in orderly manner.

k. Collect all keys upon delivery of panelboard. Store keys on one ring to be kept by project superintendent. Forward key ring with keys to OAR at substantial completion.

l. Provide a separate neutral conductor for each GFI breaker. These shall not be combined to serve more than 1 circuit, even where on different phases. Increase plan indications of conductors for neutral wires required, as necessary.

m. Conduit or piping systems that contain water or liquid of any kind shall not be installed over the top of any electrical equipment, transformers, racks, cabinets, or enclosures without prior written approval from the Owner.

3.3 IDENTIFICATION

a. Refer to Section 26 05 53 Electrical Identification for products and content.

b. Provide engraved plastic nameplates under the provisions of 26 05 53.

c. Nameplate shall show panel name, voltage and name of panel that feeds this respective panel, and UL short circuit rating.

3.4 FIELD QUALITY CONTROL

a. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

b. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

c. All circuits shall be operated to establish a good working order and checked for shorts.

d. All panel directory circuit numbers shall be checked to verify accuracy of the number.

e. Tests:

1. Test Panelboards and panelboard feeders per requirements of Section 26 00 90 Tests and Performance Verification.

2. Feeder conductors shall be checked by approved means to establish the absence of shorts to ground; insulation value, etc. and the result recorded and submitted to the Designer.

3. Submit Conductor Insulation Resistance Test per requirements of Section 26 00 90.

4. Submit Tabulation Data Voltage and Amperage Readings per requirements of Section 26 00 90.

f. Equipment Checkout:

1. Where and when requested by Designer/OAR provide (during construction):

a) Inspection of equipment by authorized equipment manufacturer technician complete with submittal of statement of findings by technician, and providing any adjustments deemed necessary for a complete and operating system.

b) Submit Equipment Checkout Memo per Section 26 00 90.

3.5 ADJUSTMENT AND CLEANING

a. Adjust operating mechanisms for free mechanical movement.

b. Tighten bus connections and mechanical fasteners.

c. Touch up scratched and marred surfaces to match original finish.

END OF SECTION 26 24 16

SECTION 26 27 26 - WIRING DEVICES

PART 1- GENERAL

1.1 RELATED DOCUMENTS

a. Drawings and general provisions of the Contract, including Contractual Conditions and Division 01 Specification sections apply to this section.

1.2 SUMMARY

a. This section includes the requirements for provision and installation of wiring devices.

1.3 DESCRIPTION

a. Provide and install all equipment, labor, material, accessories, and mounting hardware for a complete and operating system for the following:

1. Wall switches.
2. Receptacles.
3. Device plates and decorative box covers.

1.4 SUBMITTALS

a. Submit Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations including all types of wiring devices, plates and engraving.

b. Submit Manufacturer's Instructions:

1. Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements.
2. Include instructions for storage, handling, protection, examination, preparation, operation and installation of product.

1.5 QUALIFICATIONS

a. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years experience.

1.6 REFERENCES AND REGULATORY REQUIREMENTS

a. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

- b. Conform to the requirements of the following:
 - 1. ANSI/NFPA 70 - National Electrical Code
 - 2. NEMA WD 1 - General Purpose Wiring Devices.
 - 3. NEMA WD 5 - Wiring Devices, Special Purpose
 - 4. NEMA WD 6 - Wiring Device Configurations.

PART 2- PRODUCTS

2.1 GENERAL

- a. All devices shall be Specification Grade as minimum.
- b. General purpose wiring devices shall meet NEMA standard WD-1, wiring devices, general purpose. Special purpose devices shall conform to the requirements of NEMA standard WD-5, wiring devices, special purpose.
- c. All wiring devices shall bear UL labels.
- d. All devices of one type shall be by the same Manufacturer.
 - 1. "Hazardous Location" and special purpose devices as may not be available from the same manufacturer shall constitute the only exception to this requirement of single source.
- e. Corrosion resistant devices shall be as specified for normal usages, and fabricated of yellow color melamine plastic. Where "Weatherproof" type is indicated for exterior or wet locations, provide matching self-closing cover, with gasketed seals at plate/wall junctions and for cover.
 - 1. Provide factory packaged wiring devices having high impact strength molded plastic bodies.
- f. Except where specifically required, the use of interchangeable type or combination switch-receptacle-pilot devices are not acceptable.

2.2 WALL SWITCHES

- a. General:
 - 1. Snap switches for general use shall be maintained contact types, and shall be single-pole, double-pole, three-way, or four-way as required for the specific switching arrangements shown on the drawings. They shall be quiet tumbler operation types, having silver alloy contacts, and meeting all NEMA performance standards. Color to match plates unless specifically noted otherwise.
 - 2. Switches shall be toggle or key-operated types, as indicated on the drawings. All key-operated switches shall be keyed alike.

3. Where switches are denoted as having pilot lights, pilot lights shall glow when the switches are "ON". Provide pilot light switch with lamp and miniature step-down transformer. The pilot light shall have a red lens, and the lamp shall be long-life type.
 4. Jewels for use with switches controlling motors shall be green, and jewels for other purposes shall be amber. All units shall be front relampable.
 5. Snap switches installed in hazardous locations shall be UL listed for the type of location (class and division).
 6. Switches connected to emergency power shall have red lighted handles which shall illuminate when the switches are "Off".
 7. Voltage and ampere rating of switches shall be marked on switch, and shall conform to voltage of system to which applied.
 8. Switches shall have back and side wired screw pressure terminals.
- b. Description: NEMA WD 1, heavy-duty, AC only general-use snap switch.
 - c. Voltage Rating: 120-277 volts, AC.
 - d. Current Rating: 20 amperes minimum.
 - e. Ratings: Match branch circuit and load characteristics.

2.3 RECEPTACLES

- a. General:
 1. All receptacles shall be of standard NEMA configuration, as indicated on the drawings, and shall comply with the respective ANSI C73 series standard for the NEMA configuration. Color to match plates unless specifically noted otherwise.
 2. Duplex receptacles shall have integral UL listed self-grounding clips. Similar, single receptacles shall be provided for plug-in connections of industrial fluorescent light fixtures on the same switching circuit. Receptacle face to be impact resistant nylon.
 3. Weatherproof duplex receptacles shall be provided in all exterior locations, and shall be Ground Fault Circuit Interrupting (GFCI) types, with weatherproof stainless steel cover plates.
 4. Special purpose receptacles for specific equipment shall be grounding types, having the number of poles, voltage and ampere ratings, and NEMA configurations required by the equipment. For each special purpose receptacle, provide an identical mating plug equipped with cord grip, secured to cord.
 5. Duplex receptacles shall have back and side wired screw pressure terminals.

6. Receptacles to be installed in shower rooms, locker rooms, toilet rooms, janitors closets, exterior, elevator pit and machine rooms, escalator pits, within six (6) feet of a sink, and other areas as required by NEC, and OSHA Standards shall be ground fault circuit interrupting (GFCI) type, whether specified or not.
7. Receptacles installed for water coolers shall be GFCI type, or a single receptacle as permitted by NEC.
 - b. Description: NEMA WD 1; heavy-duty general use receptacle.
 - c. Configuration: NEMA WD 6; heavy-duty, general use type as specified and indicated.
 - d. Convenience Receptacle: Type 5-20.
 - e. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter, and automatic "self-testing feature" to meet regulatory requirements.

2.4 COVER PLATES

- a. All wiring devices shall be provided with standard size one-piece cover plates of suitable configuration for the number and type of devices to be covered.
- b. Metallic cover plates shall be used in interior spaces, except as noted below, and shall be fabricated of corrosion-resistant #302 stainless steel, having a nominal thickness of .04", and a brushed finish. Screws securing the plates shall have flush (when installed) heads with finish to match plates. Metallic cover plates shall meet all requirements of the National Electrical Code and Federal Specifications.
- c. Cover plates for switches located in corrosive atmospheres (where vaporproof is not indicated) shall consist of a one piece neoprene boot with matching pressswitch.
- d. Cover plates for exterior receptacles shall be gasketed covers with hinge allowing plug and cord to be plugged in and activated with cover closed..
- e. Cover plate engraving, where required, shall be accomplished by cover plate manufacturer in accordance with instructions given on the drawings. Metallic plates and nylon plates in ivory, beige, gray, and white shall be engraved with black fill. Red, brown, and black nylon plates shall be engraved with white fill.
- f. Plates for devices connected to emergency power shall be as specified for devices connected to normal circuits, but shall be engraved reading "Emergency", see drawings for other engraving requirements.
- g. Plates for devices connected to computer power panels shall be engraved reading "Computer". Devices connected to emergency computer power panels shall be red in color.
- h. Plates for devices connected to UPS power systems shall be as specified for devices connected to normal circuits, but shall be engraved reading "UPS POWER", see drawings for other engraving requirements.

i. Unless specifically noted otherwise in specs or on drawings all outlets for telephone and other communications and data systems shall be provided with standard size one-piece cover plates having a minimum 3/4 inch diameter, with bushing, in the center unless specifically noted otherwise. Where telephone conductors are installed, plates shall contain telephone type, polarized plug-in receptacles.

j. Device plates located in secure areas, as noted on drawings, shall have security wall plates (10 gauge) with 12 gauge galvanized steel backplate. All device plates shall have tamperproof screws.

2.5 COLOR

a. Wiring devices connected to normal power shall be gray unless specifically noted otherwise.

b. All devices and coverplates in paneled walls shall have finish to match paneling.

c. Devices connected to emergency power shall be red color. (Including devices connected to emergency computer power panels).

d. Devices connected to separate computer power panels shall be black in color.

e. Modify any given catalog numbers as required to procure devices and plates of the proper color.

f. Devices connected to UPS systems shall be orange (isolated ground).

PART 3 - EXECUTION

3.1 EXAMINATION

a. Verify outlet boxes are installed at proper height.

b. Verify wall openings are neatly cut and will be completely covered by wall plates.

c. Verify floor boxes are adjusted properly.

d. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

a. Provide extension rings to bring outlet boxes flush with finished surface.

b. Clean debris from outlet boxes.

3.3 INSTALLATION

a. Install products in accordance with manufacturer's instructions.

b. Install devices plumb and level.

- c.** Install switches with OFF position down.
- d.** In general, lighting control switches shall be located at the lock/strike plate side of door(s). If the drawings indicate otherwise, issue a request for clarification prior to rough-in.
- e.** Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
- f.** Do not share neutral conductor on load side of dimmers.
- g.** Install receptacles with grounding pole on bottom.
- h.** Where 2 or more switches or receptacles are to be installed adjacent to one another, provide a multi-gang coverplate. Provide proper NEC barriers in boxes which serve devices for both the Normal and Emergency Systems or a combined system voltage of 480 volt.
- i.** Provide device coverplates for every device installed. Cover plates shall be installed so that they appear straight with no gaps between plate edges and the wall. Maintain vertical and horizontal to within 1/16 of an inch.
- j.** In finished areas, provide same type of plate for all surface mounted devices as for recessed mounted devices.
- k.** In any room, where new and existing construction is present, all receptacles, switches, and coverplates which are existing to remain shall be changed, to match new work.
- l.** Wiring devices shall not be installed in exposed masonry until cleaning of masonry with acids has been completed.
- m.** All receptacles and switches shall be grounded by means of a ground wire from device ground screw to outlet box screw and branch circuit ground conductor. Strap alone will not constitute an acceptable ground.
- n.** All wiring devices, relays, contactors, pushbuttons, selector switches, pilot lights, etc. shall be installed in approved enclosures rated for the appropriate NEMA classified environment.
- o.** All devices shall be installed so that only one wire is connected to each terminal.
- p.** Once construction is substantially completed, replace all damaged, burned, or scorched wiring devices.
- q.** Receptacles shown to be floor mounted shall be installed in floor boxes (with coverplates) which are approved for this use.
- r.** Connect wiring devices by back wiring conductor into compression terminal.
- s.** Install protective rings and split nozzle on active flush cover service fittings.

3.4 NEUTRAL CONDUCTOR CONNECTIONS

a. At each receptacle "in" and "out" phase and neutral conductors shall have an additional conductor "pigtail" for connection to device. The practice of "looping" conductors through receptacle boxes shall not be acceptable.

3.5 INTERFACE WITH OTHER PRODUCTS

a. Coordinate locations of outlet boxes to obtain specified mounting heights.

3.6 FIELD QUALITY CONTROL

- a. Inspect each wiring device for defects.
- b. Operate each wall switch with circuit energized and verify proper operation.
- c. Verify that each receptacle device is energized.
- d. Test each receptacle device for proper polarity.
- e. Test each GFCI receptacle device for proper operation.

3.7 ADJUSTING

a. Adjust devices and wall plates to be flush and level.

END OF SECTION 26 27 26

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SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1- GENERAL

1.1 RELATED DOCUMENTS

a. Drawings and general provisions of the Contract, including Contractual Conditions and Division 01 Specification sections apply to this section.

1.2 SUMMARY

a. This section includes the requirements for provision and installation of enclosed switches and circuit breakers.

1.3 DESCRIPTION

a. Provide all labor, materials, and equipment necessary to properly install switches as shown on the drawings and as required by codes.

b. Coordinate with Division 23 for disconnect switches for mechanical equipment. Provide all other disconnect switches required for a complete operating system.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

a. Deliver switches in factory wrapped packaging. Handle switches carefully to prevent damage. Store in a clean, dry space protected from dirt, water, and physical damage. Reject damaged switches.

1.5 SUBMITTALS

a. Submit catalog cut sheet on each type of disconnect switch to be used on this project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- a. Eaton
- b. Siemens
- c. Square D.

2.2 CONSTRUCTION

- a. Switches shall be heavy-duty type with visible, quick-make, quick-break blades.
- b. Units for 2-speed motors shall be 6-pole in a single enclosure. Use of 2, 3-pole units will not be acceptable.
- c. Provide ground bus and where required, a solid neutral bus.

- d.** Switches shall be fusible or non-fusible as noted on the drawings or as required by the equipment served from the switch. Fusible switches shall have rejection type fuse holders.
- e.** Terminal lugs shall be rated for 75 degrees Centigrade.
- f.** Enclosures, unless otherwise noted, shall be:
 - 1.** Interior dry locations shall be NEMA 1.
 - 2.** Wash-down areas, interior wet locations or similar shall be NEMA 3R stainless steel watertight, corrosion resistant.
 - 3.** Exterior locations shall be NEMA 3R
- g.** The enclosure shall be interlocked with the switch handle such that the enclosure door or cover cannot be opened with the switch in the "ON" position. The switch handle shall be capable of being padlocked in the "OFF" position but not in the "ON" position.
- h.** Finish for NEMA I units shall be standard baked gray enamel finish over a rust inhibiting phosphate primer.

2.3 RATING

- a.** The size, number of poles, and fusing for each switch shall be as noted on the drawings. As a minimum, no less than one pole for each ungrounded conductor shall be provided. Switches shall be rated 250 VAC or 600 VAC as required by the circuit to which it is connected.
- b.** Switches serving motors with more than one set of windings shall have the number of poles necessary to disconnect all conductors to all windings in a single switch.
- c.** Switches serving motor loads shall be horsepower rated to match motor and of sufficient size to handle the load regardless if rating noted on drawings is provided in ampere.

2.4 SERVICE ENTRANCE EQUIPMENT

- a.** Switches used as service entrance equipment shall be listed and labeled by UL for use as service equipment.

2.5 FUSES

- a.** General:
 - 1.** All fuses shall be of the same manufacture to retain selectability as designed. No fuse shall be installed until equipment is ready to be energized and after tightening of all electrical connections, inspection of all ground and grounding conductors and a megger test of adequate insulation to ground of all circuits.
 - 2.** All fuses shall be current limiting with 200,000 amperes interrupting capacity.
 - 3.** Fuses rated 601 amperes and larger shall be UL Class L and have a minimum time-delay of 45 seconds at 300% rating and have O-ring gas seals at the end bells.

4. Fuses rated 600 amperes or less, installed ahead of circuit breakers or circuit breaker panels, shall be UL Class K-1.
 5. Fuses rated 600 amperes or less for all general power circuits shall be dual-element, UL Class RK-5 time-delay type. They shall be self protecting from extraneous heat.
 6. Fuses installed in individual motor circuits shall be dual element time-delay type, UL Class RK-5. Provide fuse reducers when necessary.
 7. Fuses called for to be rejection type are to have rejection fuse holders.
 8. Fused disconnect switches for elevators and escalators shall have rejection fuse holders.
- b. Fuse Requirements:
1. Dimensions and Performance: NEMA FU 1, Class as indicated.
 2. Voltage: Rating suitable for circuit phase-to-phase voltage.
 3. Power Load Feeder Switches Larger than 600 amperes: Class L (time delay).
 4. Power Load Feeder Switches: Class RK1 (time delay) or RK5 (based on load).
 5. Motor Load Feeder Switches: Class RK5.
 6. Lighting Load Feeder Switches Larger than 600 amperes: Class L time delay.
 7. Lighting Load Feeder Switches: Class RK1 (time delay).
 8. Other Feeder Switches Larger than 600 amperes: Class L time delay.
 9. Other Feeder Switches: Class RK1 (time delay) or RK5 (based on load).
 10. Power Branch Circuits: Class RK1 (time delay) or RK5 (based on load).
 11. Motor Branch Circuits: Class RK5.
 12. Lighting Branch Circuits: Class G.
- c. Identification Label:
1. Provide a fuse identification label inside each fused switch, showing type and size of each fuse specified or as recommended by the manufacture of the equipment served.
 2. Labeling for rejection type fused switches shall read "Warning-Use Only Current Limiting Fuses Class , Type , MFR ".

PART 3- EXECUTION

3.1 INSTALLATION

a. Install all switches in accordance with the manufacturer's written instructions, NECA's "Standard of Installation", the applicable requirements of the National Electrical Code, and recognized industry practice.

b. All switches shall be firmly anchored to walls and supporting structures (where used). Switches shall be installed with the turning axis of their handles approximately 5'-0" above finished floor unless otherwise indicated. Provide rigid steel (galvanized for exterior use) mounting stands, brackets, plates, hardware, and accessories for a complete installation.

c. Switches shall be mounted in accessible locations. Where a switch serves as the disconnecting means for a load, the switch shall be located as close as practical to the load with the switch handle within sight of the load.

d. Provide lugs on disconnect switch as required to accept conductors called for on drawings.

e. Disconnect switches shall not be mounted on equipment, unless specifically noted or required and meet all applicable codes. If switches are noted or required to be mounted on equipment they shall have vibrator clips on fuses and be connected to conduit system with liquid tight flexible conduit.

f. Coordinate all requirements for controls between variable speed drive units and its respective motor with drive specification, manufacturer, provider and installer. Provide auxiliary contacts, relays, etc. as required.

g. Install fuses in accordance with manufacturer's instructions, the NEC, and NEMA Standards.

h. Install fuse with label oriented such that manufacturer, type, and size are easily read.

i. Label each fuse.

j. Conduit or piping systems that contain water or liquid of any kind shall not be installed over the top of any electrical equipment, transformers, racks, cabinets, or enclosures without prior written approval from the Owner.

END OF SECTION 26 28 16

SECTION 26 33 23.11 - CENTRAL BATTERY EQUIPMENT FOR EMERGENCY LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

a. Section Includes:

1. Interruptible (fast-transfer) central battery equipment.

1.2 DEFINITIONS

a. Interruptible: As used in the Section Text, an off-line, passive-standby or line-interactive, inverter-only unit, with an intentional interruption of power to the load until an internal transfer switch picks up and transfers the load to the unit's inverter and internal battery source on loss of the "normal" source, and then retransfers to the "normal" source when it is restored. Transfer time can be "slow" (up to approximately 1 second) or "fast" (2-4 ms or 40-50 ms, depending on manufacturer).

b. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.3 ACTION SUBMITTALS

a. Product Data: For each type and rating of central battery equipment unit.

b. Shop Drawings: For each type and rating of central battery equipment unit.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, ventilation requirements, method of field assembly, components, and location and size of each field connection.
3. Include system one-line diagram, internal and interconnecting wiring; and diagrams for power, signal, and control wiring.
4. Include elevation, details, and legends of control and indication displays.
5. Include -circuit current (withstand) rating of unit.

1.4 INFORMATIONAL SUBMITTALS

a. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around central battery equipment.

b. Qualification Data: For testing agency.

c. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- a. Operation and maintenance data.

1.6 QUALITY ASSURANCE

- a. UL924 Listed

1.7 WARRANTY

a. Special Warranty: Manufacturer agrees to repair or replace central battery equipment that fails in materials or workmanship within specified warranty period. Special warranty, applying to batteries only, applies to materials only, on a prorated basis, for period specified.

1. Warranty periods, from date of Substantial Completion:

- a) Central Emergency Inverter: One Year.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

a. Seismic Performance: Central battery equipment shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. The designated central battery equipment shall be tested and certified by an NRTL as meeting ICC-ES AC 156 test procedure requirements.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified[and the unit will be fully operational after the seismic event]."

2.2 EMERGENCY LIGHTING INVERTER

- a. Manufacturers:

1. Central Emergency Power System Lighting Inverter: CEPS-A-2000
2. IOTA IISC-2200-277

- b. Emergency Switching Relays:

1. Refer to 26 09 23.
2. Provide emergency relays to bypass lighting controls during power outages.

- c. General Requirements for Interruptible (Fast-Transfer) Central Battery Equipment:

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. NRTL Compliance: Fabricate and label central battery equipment to comply with UL 924.
 3. Comply with the IBC, NFPA 70, and NFPA 101.
- d. Performance Requirements:
1. Fast-Transfer Central Battery Equipment: Passive standby (off-line) system. Automatically sense loss of normal ac supply and use a solid-state static switch to transfer load.
 2. Automatic Operation:
 - a) Normal Conditions: Supply the load with ac power flowing from normal ac power input terminals, bypassing inverter, with battery connected in parallel via rectifier/charger output.
 - b) Abnormal Supply Conditions: If normal ac supply deviates from specified voltage, transfer switch operates and battery supplies constant, regulated ac power through the inverter to the load, with a momentary loss of power to the load.
 - c) If normal power fails, transfer switch operates and battery supplies constant, regulated ac power through the inverter to the load, with a momentary loss of power to the load.
 - d) If a fault occurs in system when being supplied by inverter and current flows in excess of the overload rating of inverter, inverter automatically protects itself against damage from overloads and short circuits by shutting down.
 - e) When normal ac power is restored at input supply terminals of unit, controls automatically retransfer the load back to the normal ac supply, with a momentary loss of power to the load. Rectifier/charger then recharges battery.
 - f) If normal power failure is prolonged (more than 90 minutes), integral low-voltage battery protective circuit disconnects battery and prevents battery from damage due to deep discharge.
 - g) If battery becomes discharged, and when normal ac supply is again available, rectifier/charger recharges battery. When battery is fully charged, rectifier/charger automatically shifts to float-charge mode.
 - h) If battery is disconnected, and normal ac power is available, central battery equipment continues to supply power to the load with no degradation of its regulation of voltage and frequency of output bus.
- e. Unit Operating Requirements:
1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of central battery equipment input voltage rating.

2. Input Frequency Tolerance: Plus or minus 3 percent of central battery equipment frequency rating.
 3. Minimum Off-Line Efficiency: 95 percent at 60 Hz, full load.
- f. Inverter:
1. Description: Solid-state, high-frequency, PWM type, with the following operational features:
 - a) Automatically regulate output voltage to within plus or minus 3, for all load ranges and for maximum 25 percent step-load changes; regulation may increase to 8 percent for 100 percent step-load changes.
 - b) Output Voltage Waveform: Sine wave with maximum 5 percent TDD throughout battery operating-voltage range, for 100 percent linear load.
 - c) Inverter Overload Capability: 115 percent for 10 minutes; 150 percent surge for 10 seconds.
 - d) Load Power Factor: [0.5] <Insert number> lead to [0.5] <Insert number> lag.
- g. Rectifier/Battery Charger:
1. Description: Solid state, variable rate, temperature compensated; automatically maintains batteries in fully charged condition when normal power is available.
 2. Maximum Battery Recharge Time from Fully Discharged State: 24 hours.
 3. Low-voltage disconnect circuit reduces battery discharge during extended power outages, monitors battery voltage, and disconnects inverter when battery voltage drops to no less than 85.7 percent of nominal voltage.
- h. Batteries:
1. Description: Sealed Lead Calcium or Valve Regulated Lead Acid (VRLA) .

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

a. Coordinate layout and installation of central battery equipment with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

b. Wall-Mounted Central Battery Equipment: Install central battery equipment on walls with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished floor unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For units not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."

c. Wiring Method:

1. Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
 - a) Install plenum cable in environmental air spaces, including plenum ceilings.
 - b) Comply with requirements for cable trays specified in Section 260536 "Cable Trays for Electrical Systems."
 - c) Comply with requirements for raceways specified in Section 260533.13 "Conduits for Electrical Systems."
2. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

d. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

e. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

f. Separately Derived Systems: Make grounding connections to grounding electrodes and bonding connections to metallic piping systems as indicated; comply with NFPA 70.

g. Install control wiring between central battery equipment and remote devices.

h. Identify central battery equipment, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

a. Perform tests and inspections.

b. Tests and Inspections:

1. Inspect central battery equipment, wiring, components, connections, and equipment installation.
2. Test continuity of each circuit.
3. Perform each visual and mechanical inspection and electrical test stated in manufacturer's written instructions and in NETA Acceptance Testing Specification, including specifically those for batteries, battery chargers, and UPS, regardless of the type of central battery equipment provided. Certify compliance with test parameters.
4. Perform a load-duration test at rated voltage and rated output current to verify the correct functional operation of the unit under full-load stable operating conditions for

the minimum time limits required by UL 924. Monitor and record ambient temperature and temperatures within the unit.

5. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
6. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

c. Central battery equipment will be considered defective if it does not pass tests and inspections.

d. Prepare test and inspection reports, including a certified report that identifies central battery equipment and describes all test results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.3 DEMONSTRATION

a. Engage with Owner's maintenance personnel to adjust, operate, and maintain central battery equipment.

END OF SECTION 26 33 23.11

SECTION 26 33 53 - STATIC UNINTERRUPTIBLE POWER SUPPLY

PART 1 - GENERAL

1.1 SUMMARY

- a. Section Includes:
 - 1. Rack mounted UPS

1.2 ACTION SUBMITTALS

- a. Product Data: For each type of UPS.
- b. Shop Drawings: For UPS.
 - 1. Include equipment data sheet with highlighted part numbers.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

- a. Provide manufacturer Operation and maintenance manuals.

1.4 WARRANTY

a. Special Battery Warranties: Manufacturer and Installer agree to repair or replace UPS system storage batteries that fail in materials or workmanship within warranty period of one year.

b. Special UPS Warranties: Specified form in which manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within one year warranty period.

PART 2 - PRODUCTS

2.1 RACK MOUNT UPS

- a. Description: Self-contained battery backup device and accessories that provide electrical power in the event of failure or sag in the normal power system.
- b. Electronic Equipment: Solid-state devices using hermetically sealed, semiconductor elements. Devices include rectifier-charger, inverter, static bypass transfer switch, and system controls.
- c. Enclosures: Comply with NEMA 250, Type 1, unless otherwise indicated.

- d. Standard 19" Rack Mount.
- e. Input Power: 120VAC. Provided with Cord and L5-15P plug.
- f. Output rating: 1440 VA output minimum
- g. Output receptacles: Minimum (6) 5-20R plugs.
- h. Integral Lead Acid or Lithium-Ion batteries.
- i. Manufacturer:
 - 1. Eaton 5PX1500RTG2
 - 2. Accepted Equal from American Power Company (APC)

PART 3 - EXECUTION

3.1 INSTALLATION

- a. Examine areas and conditions, with Installer present, for compliance with requirements for conditions affecting performance of the UPS.
- b. Comply with NECA 1.
- c. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for raceways and boxes specified in Section 260533.13 "Conduits for Electrical Systems."
- d. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- e. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.2 GROUNDING

- a. Bond UPS to ground bar in cabinet with #6 ground conductor. Follow all manufacturer instructions for proper grounding for proper function of integral surge protection.

3.3 FIELD QUALITY CONTROL

- a.** Inspect interiors of enclosures, including the following:
 - 1.** Component type and labeling verification.
 - 2.** Ratings of installed components.
- b.** Test static transfer from Normal to UPS power.
- c.** The UPS system will be considered defective if it does not pass tests and inspections.

END OF SECTION 26 33 53

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SECTION 26 41 13 - LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

a. Drawings and general provisions of the Contract, including Contractual Conditions and Division 01 Specification sections apply to this section.

1.2 SUMMARY

a. This section includes the requirements for provision and installation of a complete lightning protection system.

1.3 DESCRIPTION

a. A Lightning Protection System shall be provided and installed on the structure even though not shown on drawings, by experienced LPI Certified Installers in compliance with provisions of Code for Lightning Protection Systems as adopted by the National Fire Protection Association and Underwriters' Laboratories. All equipment to that result shall be included whether or not specifically called for herein with the additional requirement that the system shall meet all the requirements of LPI.

b. Materials shall comply in weight, size and composition with the requirements of Underwriters' Laboratories and the National Fire Protection Code relating to this type of installation, and shall be UL Labeled.

c. All materials, where available by any one manufacturer, shall be cast.

d. System shall comply with the following:

1. LPI

2. ANSI/NFPA 780; Class I (Class II for buildings over 75 feet in height)

3. UL 96A; Master Label for:

a) New installation

1.4 REFERENCES

a. ANSI/NFPA 780 - Lightning Protection Code.

b. ANSI/UL 96 - Lightning Protection Components.

c. LPI - Lightning Protection Institute.

d. UL 96A - Installation Requirements for Lightning Protection Systems.

1.5 SUBMITTALS

a. Submit shop drawings showing layout of air terminals, grounding electrodes, and bonding connections to structure and other metal objects. Include terminal, electrode, and conductor sizes, and connection and termination details. Drawings shall include full layout of cabling and points, and connections.

b. Submit product data showing dimensions and materials of each component, and include indication of listing in accordance with ANSI/UL 96.

c. Submit manufacturer's installation instructions.

d. Submittal shall include ground rods and ground wells as called for in Section 26 05 26 – Grounding and Bonding.

1.6 PROJECT AS-BUILT DOCUMENTS

a. Record actual locations of air terminals, grounding electrodes, bonding connections, and routing of system conductors on red lined as-built documents.

1.7 QUALIFICATIONS

a. Manufacturer: Company specialized in lightning protection equipment with minimum five (5) years documented experience and member of the Lightning Protection Institute.

b. Installer: Authorized installer of manufacturer with minimum five (5) years documented experience and member of the Lightning Protection Institute.

1.8 SEQUENCING AND SCHEDULING

a. Coordinate the work of this Section with roofing and exterior and interior finish installations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

a. Thompson Lightning Protection, Inc.: Premium Line.

b. Independent Protection Company, Inc.: Premium Line.

c. Heary Bros. Lightning Protection: Premium Lines.

2.2 MATERIALS

- a. Components: In accordance with ANSI/UL 96 and LPI.
- b. Air Terminals:
 - 1. Air Terminals shall be solid (aluminum) as required to match roof conductors, and shall have proper base support for surface on which they are attached, and shall be securely anchored to this surface.
 - 2. Terminal length: Comply with NFPA 780.
 - 3. Air Terminal for Chimneys: Lead-coated copper.
- c. Conductors:
 - 1. Roof conductors shall consist of aluminum complying with the weight and construction requirements of the Code. Roof conductor material shall match and be compatible with roof flashing material.
 - 2. Down conductors shall be copper, and shall be provided where shown installed in PVC conduit and hidden within the structure.
- d. Fastener: Conductor fasteners shall be of the same material as the conductor, having ample strength to support conductor.
- e. Connectors and Splicers: Bronze or aluminum as required to be compatible with conductor being connected.
- f. Ground Rods: Comply with all requirements of Sections 26 05 26.

PART 3 - EXECUTION

3.1 EXAMINATION

- a. Verify that surfaces are ready to receive work.
- b. Verify that field measurements are as shown on shop drawings.
- c. Beginning of installation means installer accepts existing conditions.

3.2 PROTECTION OF SURROUNDING ELEMENTS

- a. Protect elements surrounding work of this Section from damage or disfiguration.

3.3 INSTALLATION

- a. Install in accordance with manufacturer's instructions.
- b. Install in accordance with UL 96A, ANSI/NFPA 780, and LPI.

c. Install ground rods in accordance with Section 26 05 26. Where conflict exists between the requirements of Section 26 05 26 and this Section, the most stringent shall govern.

d. Installation shall be made in an inconspicuous manner with conductors routed to conceal as much as possible. Down conductors shall be concealed within structure, and shall be run in 1" PVC conduit. See Paragraph 'F' below and NFPA 780 4.15.1.

e. Where fasteners are to be mounted in masonry or structural work, they shall be furnished to the Masonry or Structural Contractor so they may be installed during construction of the project.

f. Conductors concealed in steel reinforced concrete shall be installed and bonded per NFPA 780 4.15.3. Specific attention is brought to the requirements of 4.9.13 requiring down conductors to be connected to reinforced steel at its upper and lower ends.

g. Lightning protection system shall be bonded to metal bodies as required by NFPA 780 4.21.

h. Provide proper connections of lightning protection system to all grounded media in and around the protected structure per NFPA 780 4.20 "Potential Equalization".

i. Provide proper grounding of all grounding media in, on and around structure to provide common ground potential per NFPA 780 4.14 including electric service, telephone and antenna system grounds as well as underground metallic piping systems, underground metal conduits, etc.

j. Ground Ring: Bond to ground ring system. See Section 26 05 26. Items required to be bonded/connected in 'H' and 'I' above shall be bonded/connected via ground ring system where available and applicable.

k. All exposed conductors located 6 ft. or less above finished floor or finished grade are to be suitably protected/shielded as well as other exposed locations where conductor is subject to mechanical damage.

l. Coordinate and receive approval of all penetrations of roofing system and mounting to roofing system with Designer and Roofing Contractor prior to submittal of shop drawings.

m. Coordinate and receive approval of all connections to structural steel, rebar, and other structural elements with Structural Engineer prior to submittal of shop drawings.

n. Ground Terminals:

1. Ground connections shall be made in accordance with requirements of all applicable codes and Section 26 05 26 (including but not limited to requirements for testing, ground rods, materials, wells, etc.).

2. Ground rods shall be placed outside, a minimum of two (2) feet from building foundations. Top of rod shall be at least one (1) foot deep into earth (i.e., with minimum earth cover of one (1) foot).

3. Each and every ground rod location shall consist of:
 - a) Two or more 30 ft. ground rods (5/8" copper) at no less than 30 ft. spacing shall be driven vertically to a depth resulting in one (1) foot earth cover.
 - b) Bond the two or more ground rods together with a cable size that meets the applicable requirements of NFPA 780 for Class I or II locations as applicable.
 - c) Provide additional rod electrodes as required to achieve specified ground resistance.
 - d) Complete installation shall exceed the minimum requirements of NFPA 780.
 - e) Provide grounding well enclosure at each ground rod location in accordance with Section 260526.

3.4 FIELD QUALITY CONTROL

- a. Test grounds per Section 26 05 26.
- b. Obtain UL Master Label and attach to building at location directed by OAR. Submit in O & M Manual.
- c. Submit test results on each ground location including final length of each ground rod and final distance between each installed ground rod at each ground rod location.

END OF SECTION 26 41 13

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SECTION 26 43 13 - SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

a. Drawings and general provisions of the Contract, including Contractual Conditions and Division 01 Specification sections apply to this section.

1.2 SUMMARY

a. This section includes the requirements for provision and installation of surge suppression equipment for 120 volt AC to 480 volt AC circuits.

1.3 DESCRIPTION

a. Provide all materials, labor and auxiliaries required to furnish and install complete surge suppression for the protection of building electrical and electronics systems from the effects of line induced transient voltage surge and lightning discharge as specified for systems with voltages between 120VAC and 480VAC.

b. Provide surge suppression equipment for the following equipment:

1. Each new main electrical service switchboard.
2. Distribution and branch panels as called for on drawings.
3. Point of use locations (receptacles, plug-in units) as required.

c. All surge protection to be connected via a 30A 3 pole circuit breaker (whether shown on Plans/Schedules or not.)

1.4 SUBMITTALS

a. Submit the following Product Data for each type of suppressor:

1. Dimensions
2. Means of mounting
3. Compliance with UL Standards referenced
4. Compliance with IEEE Standards referenced
5. Design type (Hybrid, MOV)
6. Internal fusing/Thermal Protection

7. Recommended overcurrent protection
8. Size of wire leads
9. Visual failure indicator
10. Warrantee
11. Performance data showing compliance with performance as specified herein
12. Non-Potted construction

1.5 PROJECT AS-BUILT DOCUMENTS

a. Record locations of surge protection units; indicate actual units used on red lined as-built documents.

1.6 OPERATION AND MAINTENANCE DATA

- a. All approved shop drawings, product data, and cutsheets.
- b. Installation, connection, and maintenance information on each type of surge suppression.
- c. Procedure and time table for recommended periodic inspection of devices to determine usefulness and life expectancy.

1.7 QUALITY ASSURANCE

- a. All surge suppression devices shall be manufactured by a company normally engaged in the design, development, and manufacture of such devices for electrical and electronics systems equipment.
- b. The surge suppressor manufacturer shall offer technical assistance through support by a factory representative and local stocking distributor. Factory representatives are to approve installation prior to Substantial Completion.

1.8 REFERENCES AND REGULATORY REQUIREMENTS

a. Equipment Certification: Surge suppression equipment shall be UL listed and labeled for intended use.

b. Surge suppression devices shall be selected, installed and located in accordance with requirements of the following:

1. ANSI/NFPA 780 - Lightning Protection Code, latest edition.
2. ANSI/NFPA 70 - National Electrical Code, current adopted year.
3. U.L. 1449 – 3rd Edition, Standard for Safety for Surge Protective Devices.
4. 1363-1986 - Standard for Temporary Power Taps.
5. ANSI/IEEE C62.41-1991 (IEEE 587) - Guide for Surge Voltages in Low-Voltage AC Power Circuits.
6. ANSI/IEEE C62.33-1982 - Standard Test Specifications for Varistor Surge Protection Devices.
7. ANSI/IEEE C62.45-1987 - IEEE Guide for Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.

1.9 COORDINATION/PROJECT CONDITIONS

- a. Verify proper grounding is in place.
- b. Verify if space and proper clearance for the surge suppressor installation is available.
- c. Coordinate so that proper overcurrent device, as recommended by manufacturer, is installed to feed each surge suppression device.

1.10 WARRANTY

- a. All surge suppression devices shall be warranted to be free from defects in materials and workmanship for a period of five (5) years.
- b. Any suppressor which shows evidence of failure or incorrect operation during the warranty period shall be repaired or replaced at no cost to the owner.

PART 2 - PRODUCTS

2.1 GENERAL

- a. Suppressors shall be designed for the specific type and voltage of electrical service and shall provide clamping action for both normal (L-N) and common (L-N-G) mode protection.
- b. Suppressors shall be of a hybrid design, and include circuitry with tight, wave-tracking clamping characteristics.

c. Suppressors shall be designed to withstand a maximum continuous operating voltage of not less than 115% of nominal RMS line voltage.

d. Suppressors shall contain internal safety fusing to disconnect the suppressor from the electrical source if the suppressor fails, in order to prevent catastrophic failure modes.

e. Suppressors shall be fail safe, shall allow no follow-thru current, shall have repeated surge capability, shall be solid state, shall be self-restoring, and shall be fully automatic.

f. Suppressors shall be UL 1449 listed and shall be approved for the location in which they are installed.

2.2 SUPPRESSOR CRITERIA

a. Main Electrical Service Entrance Suppressors (First Level of Protection) shall meet or exceed the following:

1. General:

a) Type 1 Surge Suppressor

b) Suppressors shall be tested as per IEEE C62.41-1991 to determine clamping voltage using Cat. C3 test criteria.

c) Suppressors shall be sequential surge tested as per IEEE C62.45-1987, and shall withstand 1000 test cycles at 10kA, Cat. C3 test criteria.

d) Internal fusing for each phase connected.

e) Fail-safe with no hold over current.

f) Enclosure:

1) listed.

2) Fire retardant.

3) NEMA 1 as required for each location.

g) Surge Current per Phase: 200,000 Amps. per phase.

h) Clamping voltage:

1) Category B, UL 1449, Line to Neutral impulse (6KV - 1.2 x 50 μ s, 3kA - 8 x 20 μ s):

a. 120/208V, 3 \emptyset , 4W: 600V

b. 277/480V, 3 \emptyset , 4W: 920V

2) Category C3, Line to Neutral impulse (20KV - 1.2 x 50 μ s, 10kA - 8 x 20 μ s):

a. 120/208V, 3 \emptyset , 4W: 1160

b. 277/480V, 3 \emptyset , 4W: 1660

i) Basis of Design:

1) Square D SurgeLogic XDSE.

2) Equal SPD Side Mount.

3) Nvent Erco EPD

b. Branch Distribution and/or SubPanels (Second Level of Protection), suppressors shall meet or exceed the following:

1. General.

a) Level 2 Surge Suppressor

b) Suppressors shall be tested as per IEEE C62.41-1991 to determine clamping voltage using Cat. B3 test criteria.

c) Suppressors shall be sequential surge tested as per IEEE C62.45-1987, and shall withstand 1000 test cycles at 3kA, Cat. B3 test criteria.

d) Internal fusing for each phase connected.

e) Fail-safe with no hold over current.

f) Enclosure:

1) listed.

2) Fire retardant.

3) NEMA 1.

g) Surge Current per Phase: 100,000 Amps. per phase:

1) Category B, UL 1449, Line to Neutral impulse (6KV - 1.2 x 50 μ s, 3kA - 8 x 20 μ s):

a. 120/208V, 3 \emptyset , 4W: 530

b. 277/480V, 3 \emptyset , 4W: 920

h) The panel mounted unit suppressor shall be designed with redundant back-up surge

- i) *protection in the event of a module failure.
 - 1) Module status indicators shall be provided to indicate individual module status. When a module has failed, the module LED status indicator shall indicate said failure.
 - 2) Unit status indicators shall be provided to indicate the status of the complete unit suppressor. The LED status indicators shall be located on the hinged front cover to redundantly indicate module or unit failure.
- j) Basis of Design:
 - 1) Square D XDSE.
 - 2) Eaton SPD Side Mount.
 - 3) nVent Erco EPD.

PART 3- EXECUTION

3.1 GENERAL

- a. Provide suppressor at first piece of electrical equipment (switchboard) that the electrical service encounters as it enters the facility.
- b. Provide suppressor at each branch panel as noted on drawings.
- c. Provide surge suppression at location where data, metering, or monitoring equipment is connected to line voltage (120V). Provide cords and receptacles as required to connect TVSS equipment to equipment being protected and maintain UL listing.

3.2 INSTALLATION OF SUPPRESSORS

- a. Suppressors shall be installed as close as practical to the electric panel or electronic equipment to be protected, consistent with available space.
- b. Suppressors shall be close nipped to the device being protected in a position near the neutral bus which will minimize lead length between suppressor and the buses or control breaker to which the suppressor connects. Suppressor leads shall not extend beyond the suppressor manufacturer's recommended maximum lead length without specific approval of the Designer.
- c. Location shown on drawings is diagrammatic only.
- d. Suppressors shall be installed in a neat, workmanlike manner. Lead dress shall be as short and as straight as possible and be consistent with recommended industry practices for the system on which these devices are installed.

e. Supplementary grounding and bonding connections required between the bonding bus or ground plane for each equipment cluster and other locations as indicated herein shall be accomplished using #6 AWG core copper conductor and approved connections unless otherwise noted. Referenced to a common earth ground.

f. Suppressors shall be installed in a manner that allows simple replacement within short periods of downtime.

g. Suppressors other than point of use type shall be installed with a means of disconnecting the suppressor at the panel. At the main service entrance location, provide a dedicated 30 amp, 3P-CB, 100,000 A.I.C. for the TVSS device. At the distribution secondary and subpanel locations, provide dedicated 20 amp or 30 amp, 3P-CB's, for the TVSS device. Label disconnect or CB "Surge Protector". Change rating of CB's noted above as required to properly provide system as recommended by manufacturer.

h. Suppressors at main switchgear are to be mounted integral to switchgear. Comply with all codes and UL labeling. Provide UL label for complete system. All status indicators are to be mounted to switchgear door, visible from exterior of switchgear without requiring operation of door, lid, etc.

END OF SECTION 26 43 13

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SECTION 26 51 00 - INTERIOR LIGHTING FIXTURES, LAMPS, AND BALLASTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

a. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

a. This Section includes the following:

1. Interior lighting fixtures, lamps, and ballasts.
2. Exit signs.
3. Lighting fixture supports.
4. Indoor lighting is indicated by Contract Documents and shall include work necessary and incidental to completion and performance of the work.
5. Related Sections include the following:

b. The fixture catalog numbers listed on Drawings indicate manufacturer, fixture design, appearance, and performance desired. Verify ceiling system and coordinate lighting fixture trim and support requirements. Fixtures shall be modified, if necessary, to comply with drawing and specification requirements.

c. The omission of a type in the fixture schedule shall not relieve Contractor of responsibility of furnishing all required fixtures, of proper type, as shown on Drawings.

d. Do not utilize permanent lighting fixtures for temporary use unless prior written approval has been obtained from Engineer or Owner.

1.3 DEFINITIONS

- a. BF: Ballast factor.
- b. CRI: Color-rendering index.
- c. CU: Coefficient of utilization.
- d. HID: High-intensity discharge.
- e. LER: Luminaire efficacy rating.
- f. Luminaire: Complete lighting fixture, including ballast housing if provided.
- g. RCR: Room cavity ratio.

1.4 SUBMITTALS

a. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Ballast.
3. Energy-efficiency data.
4. Life, output, and energy-efficiency data for lamps.
5. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

b. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.

1. Wiring Diagrams: Power and control wiring.
2. Detail wiring for fixtures and differentiate between manufacturer-installed and field-installed wiring.

c. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Lighting fixtures.
2. Suspended ceiling components.
3. Structural members to which suspension systems for lighting fixtures will be attached.

d. Samples for Verification: Interior lighting fixtures designated for sample submission in Interior Lighting Fixture Schedule. Each sample shall include the following:

1. Lamps: Specified units installed.
2. Accessories: Cords and plugs.

e. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.

f. Operation and Maintenance Data: For lighting equipment and fixtures to include in operation, and maintenance manuals.

g. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

b. Manufacturer Qualifications: Manufacturer shall have 5 years minimum documented experience in design, production, fabrication and installation of type work required for the work. Upon request, provide proof of qualifications.

c. Comply with NFPA 70.

d. Comply with UL 468A, UL 468B and UL924

e. Comply with fluorescent lamp ballast which comply with Certified Ballast Manufacturers (CBM) Association standards and carry the CBM label.

f. FMG Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

g. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs and emergency lighting.

1.6 PRODUCT HANDLING

a. Deliver lighting fixtures in factory-fabricated containers or wrappings, which properly protect fixtures from damage.

b. Store lighting fixtures in original packaging. Store inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, laid flat and blocked off ground. Do not store fixtures outside under any circumstances.

c. Handle lighting fixtures carefully to prevent damage, breaking, and scoring of finishes. Do not install damaged units or components; replace with new.

1.7 COORDINATION

a. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.8 WARRANTY

a. Special Warranty for Drivers and Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials within specified warranty period.

1. Warranty Period for Electronic Drivers and Ballasts: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

a. Provide lighting fixtures, of sizes, types and ratings indicated; complete with, but not limited to, housing, specified lamps, lamp holders, reflectors, specified ballasts, starters and wiring.

b. Ship fixtures factory assembled, with those components required for a complete installation.

c. Design fixtures with concealed hinges and catches, with metal parts grounded as common unit, and so constructed as to dampen ballast generated noise.

d. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

e. Metal Parts: Free of burrs and sharp corners and edges.

f. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

g. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

h. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

i. Plastic Diffusers, Covers, and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

a) Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless different thickness is indicated.

b) UV stabilized.

2. Glass: Annealed crystal glass, unless otherwise indicated.

j. Electromagnetic-Interference Filters: Factory installed to suppress conducted electromagnetic-interference as required by MIL-STD-461E. Fabricate lighting fixtures with one filter on each ballast indicated to require a filter.

2.2 LED LIGHTING

a. Manufacturers

1. Manufacturer shall have at least five years of experience designing, selling, and supporting LED lighting.

b. Photometrics and characteristics

1. All LEDs used in the LED fixture shall be high brightness and of proven quality from established and reputable LED manufacturers.
2. Manufacturer shall provide optical performance, polar diagrams, and photometric data in various formats including IES file format in accordance with IES LM-79-08.
3. Photometric data shall be based on test results from an independent NIST traceable testing lab. IES data must be available and downloadable from manufacturer's Web Site.
4. Fixture shall provide a lumen output equal to that of the specified design selection.

c. General

1. High-power LED fixtures shall be thermally protected using metal core board, gap pad, and/or internal monitoring firmware thermal management techniques. LED fixture housing shall be designed to transfer heat from the LED board to the outside environment.
2. All hardwired connections to LED fixture shall be reverse-polarity protected and shall provide high-voltage protection in the event that connections are reversed or shorted during installation.
3. LED fixtures shall pass temperature range operational testing from -20° C to 50° C, pass high-temperature operating testing up to 50° C, meet lumen maintenance standards as defined in IESNA LM-80-08.
4. LED fixture shall be UL listed or UL/cUL classified, CE certified, FCC Class B compliant and California Title 24 Compliant.

d. Compliance

1. Manufacturer shall ensure that products undergo and successfully meet appropriate design and manufacturability testing, including Design FMEA, Process FMEA, environmental engineering considerations, and laboratory tests.
2. Manufacturer shall be able to provide documentation supporting the product's compliance with third-party regulations.
3. All LED fixtures shall undergo a minimum 24-hour burn-in test during manufacturing. The LED fixture shall be operated at constant and carefully regulated current levels. LEDs shall not be overdriven beyond their specified nominal voltage and current.

e. Warranty

1. LED fixtures complete including driver, must have a minimum 5 year manufacturer's warranty.

2.3 LIGHTING FIXTURE SUPPORT COMPONENTS

a. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

b. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

c. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

d. Wires: Stainless Steel aircraft cable 1/16" minimum.

e. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

f. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

2.4 SAFETY REQUIREMENTS FOR INDIVIDUAL LIGHTING FIXTURES

a. Fixtures located overhead shall have at least 1 redundant point of support. That is if one support fails the fixture shall not be capable of falling to the ground. Provide aircraft cable with nico press crimps for redundant support of fixtures with only 1 point of connection.

b. Fluorescent fixtures with lamps exposed shall have wire guards and clear tube guards to prevent the lamps or glass from falling.

PART 3 - EXECUTION

3.1 INSTALLATION

a. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

b. Install all lighting fixtures in accordance with the manufacturer's instructions and recommendations.

c. Sequence lighting installation with other work to minimize possibility of damage and soiling during remainder of construction. Protect installed fixtures from dirt and debris upon completion of installation. Clean fingerprints and smudges from fixtures and lenses.

d. Install flush mounted fixtures properly to eliminate light leakage between fixture frame and finished surface.

e. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.

1. Install a minimum of two ceiling support system rods or wires for each fixture. Locate not more than 6 inches (150 mm) from lighting fixture corners.
 2. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
 3. Fixtures supported by suspended ceiling systems shall be securely fastened to the ceiling framing member by mechanical means, such as bolts, screws, or rivets. Ceiling framing members must be securely attached to each other and to the building structure as required by all applicable codes and standards. Use of integral clips is not permitted.
- f. Suspended Lighting Fixture Support:
1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
 4. Provide redundant support for all suspended lighting fixtures.
 5. Provide threaded swivel support for fixtures mounted on sloped ceilings.
- g. Support surface mounted fixtures greater than 2 feet in length at a point in addition to the outlet box fixtures stud.
- h. Provide equipment grounding connections for indoor lighting fixtures.
- i. Adjust aimable lighting fixtures to provide required light intensities.
- j. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- k. Install clear tube guards on all exposed lamp fluorescent fixtures.

3.2 CONNECTIONS

- a. Ground equipment.
1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

- a. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

- b. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- c. Advance Notice: Give dates and times for field tests.
- d. Provide instruments to make and record test results.
- e. Tests: As follows:
 - 1. Verify normal operation of each fixture after installation.
 - 2. Emergency Lighting: Interrupt electrical supply to demonstrate proper operation.
 - 3. Verify normal transfer to battery source and retransfer to normal.
 - 4. Report results in writing.
- f. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.
- g. Corrosive Fixtures: Replace during warranty

3.4 CLEANING

- a. Clean fixtures internally and externally after installation. Use methods and materials recommended by manufacturer.

END OF SECTION 26 51 13

SECTION 26 56 00 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

a. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- a. This Section includes the following:
 - 1. Exterior luminaries with lamps and ballasts.
- b. Related Sections include the following:
 - 1. Division 26 "Lighting Poles and Standards" for exterior light poles and standards.

1.3 DEFINITIONS

- a. CRI: Color-rendering index.
- b. HID: High-intensity discharge.
- c. Luminary: Complete lighting fixture, including ballast housing if provided.

1.4 SUBMITTALS

- a. Product Data: For each luminary and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of luminary, including materials, dimensions, effective projected area, and verification of indicated parameters.
 - 2. Details of attaching luminaries and accessories.
 - 3. Details of installation and construction.
 - 4. Luminary materials.
 - 5. Photometric data based on laboratory tests of each luminary type, complete with indicated lamps, ballasts, and accessories.
 - a) For indicated luminaries, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining luminaries shall be certified by manufacturer.
 - 6. Photoelectric relays.

7. Ballasts, including energy-efficiency data.
 8. Lamps, including life, output, and energy-efficiency data.
 9. Means of attaching luminaries to supports, and indication that attachment is suitable for components involved.
- b. Shop Drawings:
1. Wiring Diagrams: Power and control wiring.
 2. Submit point to point photometric data at 10' intervals to 10' outside property line to verify lighting meets the requirements of State and Local lighting standards including any dark skies legislation. Required for any fixtures submitted other than the design selection fixtures.
- c. Samples for Verification: For products designated for sample submission in Exterior Lighting Device Schedule. Each sample shall include lamps and ballasts.
- d. Operation and Maintenance Data: For luminaries to include in operation, and maintenance manuals.
- e. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- a. Luminary Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.
- b. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- c. Comply with IEEE C2, "National Electrical Safety Code."
- d. Comply with NFPA 70.

1.6 WARRANTY

- a. General Warranty: Special warranty 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 warranty requirements of the Contract Documents.
1. Warranty Period for Emergency Fluorescent Ballast and Self-Powered Exit Sign Batteries: Five years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining four years.
- b. Special Warranty: Written warranty, signed by manufacturer and Installer agreeing to replace external parts of luminaries exhibiting a failure of finish as specified below. This

warranty is in addition to, and not a limitation of, other rights and remedies Owner may have under requirements of the Contract Documents.

1. Protection of Metal from Corrosion: 5 year warranty against perforation or erosion of finish due to weathering.
2. Color Retention: 5 year warranty against fading, staining, and chalking due to effects of weather and solar radiation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

a. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

b. In Exterior Lighting Device Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 LUMINARIES, GENERAL REQUIREMENTS

a. Luminaries shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

b. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaries.

c. Metal Parts: Free of burrs and sharp corners and edges.

d. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.

e. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaries.

f. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

g. Exposed Hardware Material: Stainless steel.

h. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

i. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

j. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

k. All site lighting fixtures/luminaries that may spill light onto adjacent properties shall have glare control shield installed on all fixtures/luminaries as required to meet the glare control requirements of applicable codes and standards. Add required glare control shield to order/model number of all site lighting fixtures.

l. All types of labels (including manufacturers and UL) shall be concealed within the body of the fixture, or accessories. The labels shall not be seen from normal viewing angles. This includes company logos unless approved in writing by the engineer.

m. All fixtures shall have gasketing material between lens door and frame to completely seal interior of fixture. Knockouts and holes in fixture housing shall be closed and sealed.

n. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminary doors.

o. Luminary Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminary before shipping. Where indicated, match finish process and color of pole or support materials.

p. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.

q. Factory-Applied Finish for Steel Luminaries: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

a) Color: As selected from manufacturer's standard catalog of colors.

r. Factory-Applied Finish for Aluminum Luminaries: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
 - a) Color: Dark bronze. Confirm color with architect prior to purchase. Architect may choose from manufacturer's standard colors.

2.3 LED LIGHTS

- a. All LEDs used in the LED fixture shall be high brightness and of proven quality from established and reputable LED manufacturers.
- b. Manufacturer shall utilize an advanced production LED binning process such as Optibin® from Philips Color Kinetics to deliver a common and repeatable color point to maintain color consistency from fixture to fixture and project to project over time, while ensuring a reliable supply of LEDs from the supplier.
- c. LED fixtures shall meet lumen maintenance standards as defined in IESNA LM-80-08.
- d. Manufacturer shall provide optical performance, polar diagrams, and photometric data in various formats including IES file format in accordance with IES LM-79-08.
- e. Photometric data shall be based on test results from an independent NIST traceable testing lab. IES data must be available and downloadable from manufacturer's Web Site.
- f. The luminary shall contain complete prewired integral drivers and an optical assembly that shall provide a distribution of Foot candle that is consistent with FBC.
- g. Labeling shall be in accordance with ANSI standards. All units shall be UL labeled.
- h. The Luminary shall meet ANSI 2G vibration standards.
- i. Finish shall be corrosion resistant polyester powder paint.
- j. The drivers shall be UL class II and operated in constant current mode. The drivers shall be prewired to the light engine. The Light engine assembly and housing shall be of the same manufacturer. The driver shall start and operate the light engine at ambient temperatures from - 0 degrees to 50 degree Celsius.

k. The system must survive 120 repetitive strikes of "B2" waveforms (IEEE/ANSI C62.41.1 1991 scenario 1 location category B) at one minute intervals with less than 10 percent degradation in clamping voltage.

l. The light engine assembly shall consist of a precision die cast aluminum heat sink, metal core printed circuit board assembly, a precision formed optical assembly comprised of injection molded high specular reflectors. The Light engine assembly shall use high brightness light emitting diodes with average CCT of 6000K and CRI greater than 70.

m. Manufacturer shall provide a 5 year warranty from date of substantial completion.

n. Test shall be performed to verify lumen output, life and color properties, CCT and CRI and shall be tested and measured in accordance with LM-80. Lumens depreciation shall be in accordance with LM-80. Lumen maintenance projections shall not exceed 6X of the available system-level lumen depreciation test data. The system shall be rated at L70/B50 for not less than 50,000 hours.

o. Manufacturer (other than the basis of design) shall provide revised photometrics for all areas to prove equal or greater photometric equivalency of the proposed LED luminaries. If additional luminaries are required, manufacturer will be responsible for all additional cost for the redesign or reconfiguration of the space.

PART 3 - EXECUTION

3.1 LUMINARY INSTALLATION

- a. Install lamps in each luminary.
- b. Install luminary in accordance with manufacturer's instruction to maintain wet location listing.
- c. Fasten luminary to indicated structural supports.
 - 1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- d. Adjust luminaries that require field adjustment or aiming.

3.2 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINARIES

- a. Install on concrete base with top flush with finished grade or surface at luminary location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-in-Place Concrete."
- b. Well fixtures shall be provided with minimum 6" depth of pea gravel below fixture for drainage or as required by manufacturer.

3.3 CORROSION PREVENTION

- a. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

3.4 GROUNDING

- a. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
 - 1. Install grounding electrode for each pole, unless otherwise indicated.
 - 2. Install grounding conductor pigtail in the base for connecting luminary to grounding system.

3.5 CONNECTIONS

- a. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.6 CLEANING AND ADJUSTING

- a. Clean units after installation. Use methods and materials recommended by manufacturer.
- b. Adjust adjustable luminaires and luminaries with adjustable lamp position to provide required light distributions and intensities.

3.7 FIELD QUALITY CONTROL

- a. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- b. Illumination Observations: Verify normal operation of lighting units after installing luminaries and energizing circuits with normal power source.
 - 1. Verify operation of photoelectric controls.
- c. Illumination Tests:
 - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):
 - a) IESNA LM-5, "Photometric Measurements of Area and Sports Lighting."
 - b) IESNA LM-50, "Photometric Measurements of Roadway Lighting Installations."
 - c) IESNA LM-52, "Photometric Measurements of Roadway Sign Installations."
 - d) IESNA LM-64, "Photometric Measurements of Parking Areas."
 - e) IESNA LM-72, "Directional Positioning of Photometric Data."
- d. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.8 DEMONSTRATION

a. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain luminary lowering devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 26 56 00

SECTION 26 56 13 – LIGHTING POLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

a. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

a. This Section includes the following:

1. Poles and accessories.

b. Related Sections include the following:

1. Division 26 Section "Exterior Lighting" for exterior luminaries.

1.3 DEFINITIONS

a. Pole: Luminary support structure, including tower used for large area illumination.

b. Standard: Same definition as "Pole" above.

1.4 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

a. Dead Load: Weight of luminary and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4.

b. Live Load: Single load of 500 lbf (2224 N), distributed as stated in AASHTO LTS-4.

c. Ice Load: Load of 3 lbf/sq. ft. (143.6 Pa), applied as stated in AASHTO LTS-4.

d. Wind Load: Pressure of wind on pole and luminary, calculated and applied as stated in AASHTO LTS-4.

1. Wind speed for calculating wind load for poles 50 feet (15 m) or less in height is 140 mph.

1.5 SUBMITTALS

a. Product Data: For each luminary, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminary, including materials, dimensions, effective projected area, and verification of indicated parameters.

2. Details of attaching luminaries and accessories.

3. Details of installation and construction.

4. Materials, dimensions, and finishes of poles.
5. Means of attaching luminaries to supports, and indication that attachment is suitable for components involved.
6. Anchor bolts for poles.
7. Manufactured pole foundations.

b. Shop Drawings:

1. Design calculations, certified by a qualified professional engineer, indicating strength of screw foundations and soil conditions on which they are based.

c. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4 and that load imposed by luminary has been included in design.

d. Operation and Maintenance Data: For poles to include in operation, and maintenance manuals.

e. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

- a. Comply with IEEE C2, "National Electrical Safety Code."
- b. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

a. Store and handle all poles in accordance with manufacturer's instructions to avoid damaging poles during delivery, storage, and handling. Special attention should be given to any wrapping on the poles to make sure that the finishes are not damaged.

1.8 WARRANTY

a. General Warranty: Special warranty 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 warranty requirements of the Contract Documents.

b. Special Warranty: Written warranty, signed by manufacturer and Installer agreeing to replace external parts of poles exhibiting a failure of finish as specified below. This warranty is in addition to, and not a limitation of, other rights and remedies Owner may have under requirements of the Contract Documents.

1. Protection of Metal from Corrosion: 5 year warranty against perforation or erosion of finish due to weathering.
2. Color Retention: 5 year warranty against fading, staining, and chalking due to effects of weather and solar radiation.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- a. Metal Parts: Free of burrs and sharp corners and edges.
- b. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- c. Exposed Hardware Material: Stainless steel.
- d. Poles and concrete bases shall comply with applicable requirements of IES, NESC, ASCE, FBC, and including but not limited to their requirements for illumination, uniformity, construction, wind loading, pole setback, breakaway, installation, glare criteria.
- e. All types of labels (including manufacturer's and UL) shall be concealed within the body of the fixture, pole or accessories. The labels shall not be seen from normal viewing angles. This includes company logo's unless approved in writing by the engineer.
- f. Manufacturer shall provide a 5 year warranty from date of substantial completion.

2.2 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

- a. Structural Characteristics: Comply with AASHTO LTS-4.
 1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in Part 1 "Structural Analysis Criteria for Pole Selection" Article, with a gust factor of 1.3.
 2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaries and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.
- b. Provide in line fusing and lightning arrestor in the handhole of all poles.
- c. Luminary Attachment Provisions: Comply with luminary manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.

d. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.

1. **Materials:** Shall not cause galvanic action at contact points.
2. **Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers:** Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.
3. **Anchor-Bolt Template:** Plywood or steel.

e. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

f. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole base flange and strength required to support pole, luminary, and accessories.

g. Breakaway Supports: Frangible breakaway supports, tested by an independent testing agency acceptable to authorities having jurisdiction, according to AASHTO LTS-4.

2.3 STEEL POLES

a. Poles: Comply with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig (317 MPa); 1-piece construction up to 40 feet (12 m) in height with access handhole in pole wall.

1. **Mounting Provisions:** Butt flange for bolted mounting on foundation or breakaway support.

b. Steel Mast Arms: Continuously welded to pole attachment plate. Material and finish same as pole.

c. Brackets for Luminaries: Detachable, cantilever, without underbrace.

1. **Adapter fitting** welded to pole and bracket, then bolted together with stainless steel or hot dip galvanized-steel bolts.
2. **Cross Section:** Tapered oval, with straight tubular end section to accommodate luminary.
3. **Match pole material and finish.**

d. Pole-Top Tenons: Fabricated to support luminary or luminaries and brackets indicated, and securely fastened to pole top.

e. Steps: Fixed steel, with nonslip treads, positioned for 15-inch (381-mm) vertical spacing, alternating on opposite sides of pole; first step at elevation 10 feet (3 m) above finished grade.

f. Grounding and Bonding Lugs: Welded 1/2-inch (13-mm) threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

g. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a 5.0 safety factor.

h. Galvanized Finish: After fabrication, hot-dip galvanize complying with ASTM A 123/A 123M.

i. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."

2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.

3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

a) Color: As selected by Architect from manufacturer's full range.

2.4 ALUMINUM POLES

a. Poles: Seamless, extruded structural tube complying with ASTM B 429, Alloy 6063-T6 with access handhole in pole wall.

b. Poles: ASTM B 209 (ASTM B 209M), 5052-H34 marine sheet alloy with access handhole in pole wall.

1. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

c. Pole-Top Tenons: Fabricated to support luminary or luminaries and brackets indicated, and securely fastened to pole top.

d. Grounding and Bonding Lugs: Welded 1/2-inch (13-mm) threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

e. Brackets for Luminaries: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.

1. Tapered oval cross section, with straight tubular end section to accommodate luminary.
2. Finish: Same as pole.

f. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

g. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

a) Color: As selected by Architect from manufacturer's full range.

2.5 POLE ACCESSORIES

a. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.

PART 3 - EXECUTION

3.1 POLE INSTALLATION

a. Align pole foundations and poles for optimum directional alignment of luminaries and their mounting provisions on the pole.

b. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features, unless otherwise indicated on Drawings:

1. Fire Hydrants and Storm Drainage Piping: 60 inches (1520 mm).
2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet (3 m).
3. Trees: 15 feet (5 m).

c. Lightning arrestor and in-line fusing are to be located at hand-hole location of pole for easy access.

d. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Division 03 Section "Cast-in-Place Concrete."

e. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.

1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
3. Install base covers, unless otherwise indicated.
4. Use a short piece of 1/2-inch- (13-mm-) diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

f. Embedded Poles with Tamped Earth Backfill: Set poles to depth below finished grade indicated on Drawings, but not less than one-fifth of pole height or manufacturers recommended installation requirements.

1. Dig holes large enough to permit use of tampers in the full depth of hole.
2. Backfill in 6-inch (150-mm) layers and thoroughly tamp each layer so compaction of backfill is equal to or greater than that of undisturbed earth or 95% compaction, whichever is higher.

g. Raise and set poles using web fabric slings (not chain or cable).

3.2 BOLLARD LUMINARY INSTALLATION

a. Align units for optimum directional alignment of light distribution.

b. Install on concrete base with top flush with finished grade or surface at bollard location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-in-Place Concrete."

3.3 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINARIES

a. Install on concrete base with top flush with finished grade or surface at luminary location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-in-Place Concrete."

b. Well fixtures shall be provided with minimum 6" depth of pea gravel below fixture for drainage or as required by manufacturer.

3.4 CORROSION PREVENTION

a. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

3.5 GROUNDING

a. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole, unless otherwise indicated.
2. Install grounding conductor pigtail in the base for connecting luminary to grounding system.

b. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole.
2. Install grounding conductor and conductor protector.
3. Ground metallic components of pole accessories and foundations.

3.6 CONNECTIONS

a. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.7 CLEANING AND ADJUSTING

a. Clean units after installation. Use methods and materials recommended by manufacturer.

3.8 FIELD QUALITY CONTROL

a. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.9 DEMONSTRATION

a. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain luminary lowering devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 26 56 13

SECTION 27 10 00 - PREMISE DISTRIBUTION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- a. Drawings and general provisions of the Contract, including Division 00 and Division 01 Specification sections apply to this Section.
- b. Section 26 05 26 Grounding and Bonding specifications, additional grounding directives specific to voice/data installations are included within this section.

1.2 SUMMARY

- a. This section includes the requirements for provision and installation of Premise Distribution Systems (PDS) cabling and pathways, comprised of voice and data subsystems.
- b. The intent of this specification is to:
 1. Identify and supplement generally accepted industry standards and practices relating to the installation and construction of Premise Distribution Systems.
 2. Emphasize portions of those standards specific to the installation and construction of Premise Distribution Systems.
 3. All work shall be subject to inspection and acceptance by Owner and the Engineer of Record, and the Authority having jurisdiction.

1.3 DESCRIPTION OF SYSTEM

- a. Furnish and install a complete Premise Distribution System (PDS). This system shall enable all Airport low voltage systems to be fully operational according to design specifications at project completion, complying with these specifications and all regulatory requirements. The system shall include but not be limited to:
 1. Backbone Pathway: Conform to ANSI/EIA/TIA-569D – 2015 using conduit, cable tray, backboards, etc. as indicated.
 2. Horizontal Pathway: Conform to ANSI/EIA/TIA-569D – 2015 using conduit, cable tray, backboards, cabinets, etc. as indicated. All cable is to be installed in conduit unless approved otherwise by the Engineer in writing as a response to a written request by a member of the Design/Project Team.
 3. All references to cable installations within this document include complete installation specifications, including but not limited to: “installed, terminated, and tested”.
 4. All references to testing include complete testing procedures, including but not limited to: “results are to be recorded in the test device, printed and submitted in hardcopy and in electronic format”. See details on testing.

5. Horizontal Wiring: Complete from Premise Distribution System Equipment to each outlet using wire and cable (copper or fiber optics) as specified.
 6. Outlets: Provide outlets as required. All cabling whether fiber optic or copper installed terminated and tested.
 7. Raceways, outlet boxes, cabinets, identification, etc.: Conform to applicable sections in these specifications.
 8. Terminal blocks telephone backboards, cabinets, racks, and similar. Conform to applicable sections in these specifications.
 9. Cabinet/Rack installations shall meet the below requirements:
 - a) All cabinets/racks if installed in a contiguous fashion shall have an inter-cabinet pathway installed at the top of cabinets for patch cables following EIA/TIA guidelines for patch cord cable management.
 - b) All cabinets/racks shall have internal vertical and horizontal cable management panels.
 - c) All cabinets if installed shall have same internal wire management and components as racks.
 - d) Cabinet/rack installations shall have overhead cable tray installed.
 - e) All cabinets/racks shall be vented for adequate airflow for proposed equipment to be installed.
 - f) All cabinets/racks shall be addressed regarding cooling, ensuring interior cooling is adequate.
 10. Patch panels - Provide and install the required patch panels for fiber optic cables and copper cables.
 11. PDS equipment is to be installed in its own equipment cabinet/rack. Each rack provided with this project shall have a 48 port patch panel for termination of CAT-6 cabling.
 12. All horizontal fiber and copper, and patch cords cable shall be secured by black Velcro wrap as necessary.
 - a) Velcro wrap shall be cut from 1 inch by 10-yard roll (industry standard supply) for cable bundles.
 - b) Individual black Velcro tie wraps may be used where appropriate.
 - c) Velcro tie wrap shall be solid black without any manufacturers name, logo, or other imprinted on wrap.
- b. Provide all power, grounding, plywood backboards and complete raceway system.

c. Completion of the structured cabling system in its entirety is required by Substantial Completion inspection, including submission of system test report documents.

1. If Owner provided or Contractor provided equipment requires the use of systems cabling infrastructure to have any Electronic Systems operational for the project to meet Substantial Completion inspection requirements the cabling infrastructure shall be complete and tested in its entirety according to a previously coordinated schedule providing reasonable and adequate time for Electronic Systems to be installed.
2. No cabling infrastructure is to be put into use without being complete and fully tested according to these and Project Engineering specifications.

d. Where any active Electronic Systems are installed by any party requiring installation of fiber or copper patch cords, all patch cords shall be permanently and properly routed in the pathway created for same, and the patch cords shall be labeled on each end with source/destination according to the Labeling Specification. All patch panel User Identification tables shall be filled out as to use/user.

1.4 SUBMITTALS

a. Product data shall be submitted on all products used to complete the scope of work of this project, including but not limited to:

1. Catalog cut sheets for each product used.
2. UL Labeling.
3. UL Verification of Category 6 equipment and material.
4. Installation instructions. Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation.
5. Manufacturers Certificate: Certify that products meet or exceed specified requirements.

b. Operation and maintenance manuals

1. Shop Drawings for enclosures shall include plans, elevations, sections, and attachment details indicating sizes of equipment, their relationship, and clear space within the enclosure.

1.5 AS-BUILT DOCUMENTS

a. As-Built documents shall include updating and revising contract documents to record actual locations (as-installed) of all equipment, pull boxes, devices,, raceways, cabling, Telecommunication Outlets, and all Premise Distribution and all Outside Plant cable infrastructure components.

b. All drawings required herein shall be in AutoCAD or Revit Latest Release or format required by Division 01 specifications.

c. Drawings required herein are in addition to those required under "OPERATION AND MAINTENANCE DATA."

1.6 OPERATION AND MAINTENANCE DATA

a. O & M Manuals shall include:

1. A complete as-installed equipment list of active (powered) components, with manufacturers' names, model numbers, serial numbers, and quantities of each item.
2. A complete and correct system schematic, showing detailed connections for all parts of the system, including wire numbers, terminal block numbers and layouts, and other designations and coding's (point-to-point wiring diagrams). System performance measurements shall be documented as noted elsewhere in this specification.
3. Riser diagrams showing as-installed conduit with pull boxes, outlet boxes, physical cable layouts, part numbers of cable types used, and number of circuits in each conduit.
4. Repair parts list for each major equipment item furnished.
5. A list of spare repair parts provided by the Project with a copy of the Transmittal Sheet showing who took receipt of and where the spare parts are stored.
6. Service manuals for each major equipment item furnished.
 - a) Manual(s) shall be submitted in digital format.
 - b) Include instructions for adjusting, operating, and extending the system
 - c) Manufacturer's warranties and operating instructions for each active equipment item furnished.
 - d) Recommended preventive maintenance procedures.
7. Data sheets showing all field labeling used for termination blocks, and cable.
8. Cable Data for all backbone (riser) and horizontal cable installed by Contractor and to include:
 - a) Manufacturer's specification sheet
 - b) Manufacturers performance and warranty sheet
 - c) Date manufactured
 - d) Part number.
 - e) Description
 - f) Attenuation specifications

- g) Bandwidth specifications**
- 9. Complete equipment rack layouts showing locations of all rack mounted patch panels, and equipment items.**

1.7 QUALITY ASSURANCE

- a. Manufacturers:** Companies specializing in manufacturing the products specified in this section have minimum 5 years documented experience.
- b. Suppliers:** Authorized distributors of specified manufacturers with minimum 5 years documented experience.
- c. Installer:**
 - 1.** The Contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size, as indicated in all references to qualifications within this document. The Contractor shall own and maintain tools and equipment necessary for successful installation and testing of optical and metallic premise distribution systems and have personnel who are adequately trained in the use of such tools and equipment.
 - 2.** The Installing Contractor must specialize in installing Premise Distribution Systems comprised of fiber optic, voice/data copper/metallic and Outside Plant cabling with minimum five (5) years documented experience as indicated in all references to Company qualifications within this document.
 - 3.** Installing Contractor shall be an authorized and designated Installer for the equipment manufacturer whose product he intends to install.

1.8 SUBSTANTIAL COMPLETION INSPECTION REQUIREMENTS

- a.** These Substantial Completion requirements are additional to Drawings and general provisions of the Contract, including Division 00 and Division 01 Specification sections apply to this Section.
- b.** The Substantial Completion inspection shall cover all locations where PDS components and/or Systems have been installed and/or modified.
- c.** The Substantial Completion inspection shall be coordinated by the Project Manager with the Contractor, Engineer of Record, and Airport.
- d.** All cabling testing and labeling shall be completed by Substantial Completion Inspection.
- e.** All cabling test result documents shall be submitted to the Airport and Engineer of Record.
- f.** All labeling documents shall be submitted to the Airport and the Engineer of Record.
- g.** If Owner provided or Contractor provided equipment requires the use of systems cabling infrastructure to have any Electronic Systems operational for the project to meet Substantial Completion inspection requirements the cabling infrastructure shall be complete and tested in its

entirety according to a previously coordinated schedule providing reasonable and adequate time for Electronic Systems to be installed.

h. Where any active Electronic Systems are installed by any party requiring use of new or existing fiber or copper backbone or horizontal cables, the installation of fiber or copper patch cords shall be complete; all patch cords shall be permanently and properly routed in the pathway created for same, and the patch cords shall be labeled on each end with source/destination according to the Airport labeling standards. All patch panel User Identification tables shall be filled out as to use/user. This must be demonstrated as complete by Substantial Completion inspection.

1.9 WARRANTY

a. Provide in Test Report submittals and O&M Manual: a separate sheet in the front of each binder stating the name, address, and phone numbers to call for both normal business hours and after-hours service.

b. The Contractor shall respond on-site with trained and certified personnel equipped with necessary testing and repair equipment to further diagnose and correct reported warranty trouble call within twenty-four (24) hours after receipt of all warranty calls.

c. Provide in Test Report submittals and O&M Manual: a separate sheet in the front of each binder stating the name, address, and phone numbers to call for both normal business hours and after-hours service.

d. The Project Manager, Airport and the Engineer of Record retain the right to use additional repair personnel as necessary to correct any warranty trouble calls and back charge the Contractor if the Contractor has been considered non-responsive to repair requests by the Owner.

1.10 REFERENCE AND REGULATORY REQUIREMENTS

a. The equipment and installation shall comply with the current or applicable provisions of the following standards:

1. ANSI/TIA/EIA TSB-67 – Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems.
2. ANSI/TIA/EIA TSB-75 – Additional Horizontal Cabling Practices for Open Offices.
3. ANSI/TIA/EIA-568-A-1995 - Commercial Building Telecommunications Cabling Standard.
4. ANSI/EIA/TIA-569A-1997 - Commercial Building Standard for Telecommunication Pathways and Spaces.
5. ANSI/TIA/EIA-606-1993 - Administration Standard for The Telecommunications Infrastructure of Commercial Buildings.
6. ANSI/TIA/EIA-607-1994 - Commercial Building Grounding and Bonding Requirements for Telecommunications.

7. ANSI/TIA/EIA-758 – Customer-Owned Outside Plant Telecommunications Cabling Standard.
8. Building Industry Consulting Service International (BICSI) Telecommunications Distribution Methods Manual.

b. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

PART 2 - PRODUCTS

2.1 GENERAL

a. All equipment shall be new and unused. All components and systems shall be designed for uninterrupted duty. All equipment, materials, accessories, devices, and other facilities covered by this specification or noted on the contract drawings shall be the best suited for the intended use and a single manufacturer shall provide component assemblies.

b. Provide all components, equipment, parts, accessories and associated quantities required for complete installations and according to Manufacturers installation specifications. All components may not be specified herein.

c. All devices/components/products shall be suitable for use intended, and meet all stated performance requirements for PDS, OSP and Systems configurations specified in this document.

2.2 TERMINATION BACKBOARDS

a. Material: 3/4" A/C grade, Class A Flame Spread plywood.

b. Size: 8' high by 4' wide with multiple sections as required to meet project requirements, unless otherwise noted or required in these specifications. See drawings and related specification sections for more information.

c. Backboard coated with UL Classified Intumescent Fire Retardant Latex

d. Install label on backboard with TTB# and Room#.

2.3 TELECOMMUNICATION GROUND BAR

a. Ground Bus shall be copper and comply with applicable sections of these specifications.

b. Install minimum one copper ground bus with qty (12) pre-drilled holes on isolating stand-offs of TTB backboard. Holes shall be configured to accept two-hole lugs.

c. Basis of Design: Harger GBI144xxTMGB or approved equal.

2.4 PATHWAYS/CONDUIT/RACEWAYS

a. General:

1. All pathways (conduit, raceways, wireways, pullboxes, outlet boxes, etc.) shall comply with applicable requirements of sections within these specifications.
2. All pathways (conduit, raceways, wireways, pull boxes, outlet boxes, etc.) shall comply with all requirements of ANSI/EIA/TIA-568-B.
3. Horizontal Pathways:
 - a) All cabling associated with the security system including cameras, access-controlled doors, and intrusion detection shall be installed in conduit.
4. All conduits shall be sized and installed per NEC and EIA/TIA specifications for intended use.
5. Size: All backbone fiber conduit shall be a minimum 2" conduit.
6. Long Radius (sweep) bends shall be used for all fiber optic cable pathways, sized per NEC and EIA/TIA specifications for intended use.
7. No conduit LBs or pathways shall be installed that force copper (metallic) cables to exceed manufacturers recommended bend radius during installation or when pulling of cable is complete.
8. For all horizontal pathways, there shall be no more than two (2) 90-degree bends without a pullbox.
9. Where a pull-box is required with raceway(s) smaller than 1-1/4 trade size, an outlet box may be used as a pull-box.
10. Where a pullbox is used with raceway(s) of 1-1/4 trade size or larger, the pull box shall:
 - a) For straight pull through, have a length of at least 8 times the trade size diameter of the largest raceway.
 - b) Pull-boxes shall not be used as direction changes but be used to pull straight through.
 - c) All pull-boxes larger than standard outlet boxes shall be individually labeled and installation location marked on As-Builts.
11. Metal flexible conduit shall not be used for PDS system.
12. Protective bushings: All backbone and horizontal conduits shall have plastic/nylon insulating bushings installed on all ends to protect cable.
13. All backbone and horizontal conduits shall have ground bonding bushings with lugs installed on all ends and be bonded to the Systems Ground Bus Bar with an insulated #6 AWG wire on all ends.

14. All conduit shall be labeled with source/destination at each end, and each main pull box.
15. Pull Cords: Install pull cords in all raceway runs including conduit and inner-ducts that are installed without cable (empty). Install a pull string or pull rope in all horizontal and backbone conduits and inner-ducts that have cable installed (used).
16. Boxes:
 - a) All outlet boxes, junction boxes, pull boxes, etc. shall comply with applicable sections of these specifications.
 - b) Outlet boxes shall be deep with a minimum size of 4" by 4" by 2-1/2" deep with a single gang sheetrock ring.
 - c) Boxes shall be sized as required by EIA/TIA and NEC for cables, both fiber and copper (metallic), conduit and/or device installed.

2.5 LABELS

a. All label material shall be suitable for intended usage and environment, meeting the legibility, defacement and general exposure requirements listed in UL 969 for indoor and outdoor use. Where insert labels are used the insert label shall be covered with clear cover and shall be securely held in place under the normal operating conditions and usage to which the labeled infrastructure element is applied.

b. Cables which shall be labeled include, but are not limited to, backbone, horizontal, patch cords, line cords, and jumpers.

c. Contractor shall install all pathway and cable labels so they are visible and able to be read by a person standing on floor without moving cables, and if conduit/pathway, labels shall not be obscured by other conduit, or components. Any additional types of labeling materials necessary to keep labels visible shall be provided by the Contractor and installed by the Contractor.

d. All metallic and fiber patch cords installed by Contractor or at direction of Contractor shall be labeled.

e. Pathways are defined but not limited to; any conduit, inner-duct, underground duct-bank, wiring troughs, pull boxes, and any wiring systems used to enclose cabling of any type.

f. Label printer shall be of the thermal transfer type capable of printing self-laminating labels of various size up to and including 1.5 inch by 1.5-inch printable area with a 4.5-inch self-laminating tail.

g. Pathways, riser fiber optic cables, and riser metallic cable labels shall have a 1.5 inch by 1.5-inch printable area white in color with a 4.5-inch self-laminating clear tail.

1. Font shall be Arial Alt Mono 7 font size (11-point size).
2. Label shall have the ability to have 15 characters per line and 8 lines for a total of 120 characters.

3. Label Basis of Design: Brady P/N PTL-34-427 or approved equal, for inside use. For exterior use label shall follow the same character format, and meet the legibility, defacement, and general exposure requirements listed in UL 969.
 4. The Airport reserves the right to modify the label characters and character layout providing label materials do not change, at no cost.
 5. For all conduit or other pathways that have a diameter too large for the self-laminating label to over-wrap itself and fully laminate the printable area the label shall be changed to an insert type (tie-on is acceptable) and meet the exposure requirements in UL 969 for indoor and outdoor use. The insert label shall be covered with clear cover and shall be securely held in place under the normal operating conditions and usage to which the labeled infrastructure element is applied.
- h. All metallic/fiber horizontal cable and metallic/fiber patch cord labels shall have a 1 inch by 5-inch printable area white in color with a 1 inch self-laminating clear tail, labeled at each end.
1. Font shall be Arial Alt Mono, 7 font size (11-point size).
 2. Label shall have the ability to have 15 characters per line and 2 lines for a total of 30 characters.
 3. Label Basis of Design is Brady P/N PTL-31-427 or approved equal, for inside use. For exterior use label shall follow the same character format, and meet the legibility, defacement, and general exposure requirements listed in UL 969.
- i. Equipment cabinet / Rack labeling
1. Provide phenolic nameplate fasted to top or racks and cabinets indicating rack / cabinet designation. Min 1" white text on black laminate.

2.6 FLOOR MOUNT EQUIPMENT RACKS/CABINETS

- a. 42 Rack Units.
- b. 42" Deep.
- c. Standard for 19" rack mounted equipment.
- d. Standard 3" x 1.25" aluminum upright channels, .125" thick.
- e. Panel Mounting Holes: #12-24 rolled threads in 5/8" - 5/8" x 1/2" hole pattern meeting ANSI/TIA-568 mounting space requirements.
 1. Use heavy-duty assembly hardware.
 - a) Provide isolation pad between rack and floor.
 - b) Base Angles: 3-1/2" x 6" x 3/8" thick (pair) for bolting to floor with 3/8" expansion anchors.

- c) Top Cross-Angles: 1-1/2" x 1-1/2" x 1/4" (pair).
- 2. Finish: Black.
- 3. All rack equipment mounting screws to be black clean thread type.
- 4. Rack Basis of Design:
 - a) Hubbel H3 Network Cabinet.
 - b) Chatsworth

2.7 PATCH PANELS - FIBER CABLE

- a. 19" rack mounted.
- b. Accommodate splicing, termination, and interconnection.
- c. Provide adaptor plate with fiber connectors. Minimum 48 strands.
- d. Steel power coated construction with rubber grommets at fiber entry points.
- e. Fiber cable splice trays shall be used for all fiber cable terminations requiring spliced pigtails.
- f. Provide splice trays as required.
- g. Provide LC type fiber connections.
- h. Manufacturer:
 - 1. Corning CCH-02U with required CCH connectors
 - 2. Approved Equal

2.8 PATCH PANEL – COPPER

- a. Category 6 UTP Patch Panel:
 - 1. Shall meet or exceed Category 6 rating for all components including but not limited to specifications within this document and as follows:
 - a) IEEE 802.3AF (POE).
 - b) IEEE 802.3AT (POE+).
 - c) IEEE 802.3BT (POE++ 60W).
 - 2. Component certified to meet or exceed Category 6 standards.

- a) Configuration: Modular RJ-45 non-keyed 8-position jack port to 110 printed circuit board, factory pre-wired, Category 6.
- b) Wire Plan: EIA/TIA T568B.
- c) Active Pins: 1 through 8.
- d) Individual patch panel size not to exceed 48 ports.
- e) One horizontal wire manager shall be installed for every 24 ports in patch panel configuration, between each patch panel(s).
- f) Connection Hardware: IDC PCB (printed circuit board) mounted connector for 22-26 AWG.
- g) Include strain relief bar.
- h) UL listed and labeled.
- i) Finish: Black.
- j) Basis of Design: Optical Cable Corporation.

2.9 TELECOMMUNICATIONS OUTLETS:

- a. Provide all Telecommunication Outlets indicated on the drawings.
- b. Provide Communication Outlet faceplates and jack modules for all type of cable media installed.
 - 1. Jacks/ports/faceplates shall be provided from the same manufacturer.
 - 2. All jacks installed in TO shall have colored bezel and dust shutter.
 - 3. The TO faceplate shall have three port positions and be white or as specified by design to match surrounding area décor.
 - 4. Faceplate shall have a recessed label area covered by a clear plastic lens, at top and bottom covering screws.
 - 5. Manufactures:
 - a) Hubbell.
 - b) Berk-Tek.

2.10 CABLE TRAY/LADDER RACK

- a. Ladder Rack (inside Communications Rooms):

- b. Ladder rack shall be spaced off the wall 4" minimum to allow for cabling to pass vertically on wall.
- c. Ladder rack width shall be 18" unless otherwise noted, refer to enlarged room plans.
- d. 1-1/2" x 0.0625" wall rectangular tubing.
- e. Cross members welded at maximum 12" intervals, 1/2" x 1".
- f. Side mounted 6" cable guide/cable fence shall be mounted every other cross member, from same manufacturer as ladder rack.
- g. Provide all accessories to support ladder rack from above and wall. Ladder rack shall not be supported from racks or cabinets. Supports shall be minimum 5/8" threaded rod.
- h. Install ceiling supports as required, eliminating lateral movement.
- i. All ladder rack mounted adjacent to walls shall be supported from the wall using brackets.
- j. Supports shall be used as specified by the cable tray manufacturer for maximum loading characteristics of cable rack.
- k. Provide supports as required by the manufacturer's installation guidelines.
- l. Edges, fittings and hardware shall be finished free from burrs and sharp edges. Ends shall have rubber boots.
- m. Fittings shall have not less than the load-carrying ability of straight tray sections and shall have manufacturer's minimum standard radius unless otherwise indicated.
- n. Furnish swept elbows for all direction changes.
- o. Bond together to form an electrically continuous path.
- p. Provide grounding kit to bond together sections of cable tray.
- q. Provide transition pans to be installed where required on cable tray.
- r. Transition pans with dividing fingers shall be installed on ladder rack above racks, cabinets and all locations required for routing copper patch cords. Transition pans shall match racking (black) in color and provided by the same manufacturer as the cable rack.
- s. Provide all warning labels as required by UL, NEC and NEMA.
- t. Finish: Black, including all accessories.
- u. Basis of Design: Chatsworth.

2.11 WIRE AND CABLE

- a. Provide all copper required to complete the Work as specified by the Project.

- b.** All cable shall be installed, terminated, and tested by Contractor.
- c.** All cable jacket and construction shall be applicable for the intended installation environment to maintain full manufacturer's warranty and industry standard expected life cycle, including but not limited to specifications within this document section.
- d.** All cable shall include additional accessories such as clamps, supports, mounting hardware, straps, anchoring structures, termination hardware, etc. necessary to provide an industry standard installation in all environments. Accessories to include but are not limited to specifications within this document section.
- e.** Copper Cabling
 - 1.** All copper cable provided in project shall meet the below general requirements:
 - 2.** Cable manufacturer shall be ISO 9001 Certified and included in the Underwriters Laboratories LAN Certification and Follow-up Program.
 - 3.** All copper cable shall utilize the appropriate sheath for the particular application. This shall be in accordance with ANSI/EIA/TIA-568-B standards. Any cable placed in space used as an air return or in any way connected with air handling plenums or building ventilation shall be low-smoke, fire retarding cable, and must comply with the National Electrical Code Articles 725, 760, and 800.
 - 4.** Unshielded 23 AWG plenum rated Category 6 rated copper cables shall be used throughout the project. The bending radius and pulling strength requirements of all cables shall be observed and documented during handling and installation.
 - 5.** Jacket: flame retardant and low smoke CMP
 - 6.** Conductor shall be solid annealed copper
 - 7.** Suitable for 10BaseT through 10Gbase-T Ethernet communications
 - 8.** PoE+ IEEE 802.3at Type 1 and 2
 - 9.** Patch Cord:
 - a)** Shall be factory made and pre-connectorized and meet or exceed the requirements of ANSI/TIA-568-C
 - b)** UL Listed as cable type CMR
 - c)** RJ-45 patch cords are to be UTP CAT6, 23AWG stranded copper
 - d)** Cord length shall come in 3', 5', and 7' lengths as determined by project requirements.
 - 10.** Manufactures:
 - a)** Superior Essex

- b) Legrand
- c) Ortronics
- d) Approved Equal

2.11 PATCH CORDS

a. CAT6 Patch Cords:

1. Provide (50) 6' Long CAT6 copper patch cords to be used by Owner for connection to owner furnished equipment adjacent Data Outlet .

PART 3 - EXECUTION

3.1 INSTALLATION

a. General

1. Provide any necessary screws, anchors, clamps, tie-wraps, velcro ties, distribution rings, raceway, grounding or other support hardware required to facilitate the proper installation of the Premise Distribution System.
2. All cable, terminating hardware, cabinets, racks, and all PDS components shall include additional accessories such as clamps, supports, mounting hardware, straps, anchoring structures, termination hardware, etc. necessary to provide an industry standard installation in intended environments. Accessories to include but are not limited to specifications within this document section.
3. Locate, install, and test the Premise Distribution System in accordance with the equipment manufacturer's written instructions; the latest editions of the National Electrical Code; the National Electrical Contractors' Association publication "Standard of Installation," according to Regulatory and Reference Documents section of this document, and all applicable codes and standards referenced in this specification.
4. Furnish any special installation equipment or tools necessary to properly complete the Work. This may include, but not be limited to, testing equipment, communication devices, jack stands, cable winches, etc.
 - a) Furnish to the Owner any specialty hand tools needed to access any covers, access hatches, or other Contractor installed enclosures.
 - b) Provide above hand tools by Substantial Completion Inspection or earlier if deemed necessary by Owner or Project Manager.
5. Install equipment, cables, raceways and outlets as required to comply with all applicable requirements within this specification document as minimum installation requirements. Exceed this minimum requirement when called for herein.
6. Install all electrical basic materials per applicable sections of these specifications.

7. Properly ground system per applicable sections of these specifications.
8. Install raceways and pathways to conform to applicable sections of these specifications.
9. Install PDS system wiring and raceways away from any surface that may become hot, including and not limited to, hot water piping and heating ducts.
10. Install PDS system wiring with at least 12 inches of separation from line voltage power wiring on parallel runs. Wiring crossing power circuits shall be at right angles. For metal enclosed electric light or power or Class 1 circuits, separation may be reduced as described in NEC 800-52 (a) (1). Increase separation if so required to comply with EIA/TIA referenced standards.
11. Maintain proper separation between PDS system cables and all power and unshielded cables, as required to prevent noise, crosstalk, etc.
 - a) Provide and install printed labels for all conduit, pathways, cables, patch cords, frames racks, enclosures, pull boxes etc.
 - b) All labeling shall be in accordance with TIA/EIA-606.
 - c) Hand written labels shall not be acceptable.
 - 1) Printed labels using Brother P Touch printers or equivalent for racks, cabinets, and enclosures in Communication Rooms will be acceptable.
 - 2) See Section Two of these specifications for Printer and Label requirements.

3.2 PATHWAYS

a. General

1. All raceways shall meet the applicable requirements of all of Divisions 26, 27, 28 Specifications, and all requirements within this specification document.
2. All raceways at terminal boards shall turn 90 degrees down and terminate at a point within 6 inches of termination board with appropriate plastic bushing, and grounding hardware.
3. Raceway shall not be shared by power or any other electrical wiring that is not part of the low voltage PDS systems. PDS system wiring may be installed in underground pull boxes with other low-voltage systems provided:
 - a) Installation meets/complies with all applicable codes and standards.
 - b) PDS system cables shall be separated by at least 12 inches from any non-shielded wire/cable.
4. Raceway Bends

- a) Bend raceway with minimum inside radius of 6 times the internal diameter.
 - b) Increase bend radius to 10 times for raceway larger than 2-inch size. Provide proper bend for all changes of direction.
 - c) Pull and splice boxes shall not be used in lieu of a direction change in raceway.
 - d) Install raceways so no more than two 90-degree bends are in any raceway section without pullbox.
 - 1) Install additional pullboxes as required to maintain maximum of two 90-degree bends between pullboxes and/or termination points.
 - 2) Label all raceway at both ends to indicate destination and PDS source room.
 - a. Length of raceway and labeling/identification shall be fully documented in as-built drawings.
 - b. As-built conduit/raceway marking nomenclature shall match exactly Identification Label format according to Airport Standard Voice and Data Infrastructure Cable and Pathways Labeling Format documentation.
 - c. Label PDS Conduits per Airport Standard Voice and Data Infrastructure Cable and Pathways Labeling Format documentation.
 - 3) Install polyethylene pulling string in each conduit whether used or empty.
- b. Sleeves**
1. Install rigid steel conduit sleeves with bushings on both ends at penetration of all walls above ceilings. Stub-out each side of wall a minimum of 8 inches or as per design.
 2. Install firestopping at sleeves and all rated firewall/smoke wall penetrations. Stub-out wall as required for routing. Firestopping assembly must comply with UL for wall routing, material and cable used.
 3. Size sleeves as required by the NEC for cable installed, but in no case shall sleeve be less than 2 inch diameter, nor smaller than that required by "4)" below.
 4. Sleeve size shall not be smaller than that required by EIA/TIA-569, Table 4.1-1, "Conduit Sizing."
- c. Cable Support**
1. Cable shall be supported in raceways according to this specification document.
- d. Horizontal Conduit and Pathways**
1. Size: Minimum pathway size to be 1" C
 2. Flexible conduit is not allowed.

3. Conduit type for location within Airport property is per Airport requirements, Codes, and Regulatory and Reference documents specified within this document.
4. Outlet boxes shall be installed at locations shown on drawings per applicable codes/standards.
5. Where a pullbox is required with raceway(s) smaller than 1-1/4 trade size, an outlet box may be used as a pullbox.
6. Where a pullbox is used with raceway(s) of 1-1/4 trade size or larger, the pull box shall:
 - a) For straight pull through, have a length of at least 8 times the trade size diameter of the largest raceway.
 - b) For angle and U pulls have a distance between each raceway entry inside the box and the opposite wall of the box of at least 6 times the trade size diameter of the largest raceway, this distance being increased by the sum of the trade size diameters of the other raceways on the same wall of the box.
 - c) Have a distance between the nearest edges of each raceway entry enclosing the same conductor of at least: six times the trade size diameter of the raceway; or six times the trade size diameter of the larger raceway if they are of different sizes.
 - d) For a raceway entering the wall of a pullbox opposite to a removable cover, have a distance from the wall to the cover of not less than the trade size diameter of the largest raceway plus 6 times the diameter of the largest conductor.
7. Where a splice box is used with raceway, it shall be sized per EIA/TIA-569, Table 4.4-2, "Splice Box Sizing".
8. No box shall be smaller than that required by NEC 370-28 (a), (1) and (2).

3.3 GROUNDING

- a. Provide and install complete grounding system as required to comply with all sections of these specifications and applicable codes.
- b. Connect telecommunication equipment to ground bar with AWG #6 THHN green jacket.
 1. Connect all horizontal and backbone metal conduit (via grounding bushing) to "systems" ground bus.
 2. Connect cable shields to "systems" ground busbar.
 3. Connect surge suppression equipment to "systems" ground busbar.

3.4 CABLES/WIRES

- a. All cable shall include additional accessories such as clamps, supports, mounting hardware, straps, anchoring structures, termination hardware, etc. necessary to provide

an industry standard installation in intended environments. Accessories to include but are not limited to specifications within this document.

- b.** All cable shall be kept on reels until it is installed. Do not roll or store cable reels without an appropriate underlay and the prior approval of the Engineer of Record. Cable on reels shall be handled, loaded, unloaded and transported by approved machinery equipped specifically for these operations.
- c.** Replace any cable found to be defective.
- d.** Do not install any Premise Distribution System cabling alongside any power circuit or device. Premise Distribution System cabling shall not share the same raceway, channel or sleeve with electrical circuits or devices.
- e.** Ensure, during installation, that the maximum pulling tensions and bend radii of the Premise Distribution System cabling (both backbone and horizontal) are not exceeded.
- f.** Install cables/wires in accordance with manufacturer's instructions and EIA/TIA 568.
- g.** All cables shall be installed as illustrated on the drawings except where necessary to avoid EMI sources or other obstacles.
 - 1.** The Engineer of Record must approve major deviations from the illustrated path in advance.
 - 2.** No splices unless specifically noted otherwise.
 - 3.** Provide adequate cable size and length for each backbone/riser run.
 - 4.** All backbone cable must be labeled per Airport Labeling Standards at every location where the cable could be exposed.
 - a)** This includes all pullboxes and pull through locations.
 - 5.** Provide and install riser/backbone cable that meets performance requirements specified, and links all systems room locations indicated on Contract Documents.
 - 6.** Spare Cable (During Installation):
 - a)** The following spare cable lengths are to be left at termination ends of conduits:
 - 1)** Computer Room/Main Telephone Room: Fiber and copper cables terminating Systems Rooms shall have enough spare cable length left to be routed to any point in the room from point of entrance to the room.
 - 2)** IT Room(s): Fiber and copper cables terminating in the IT Room(s) shall have enough spare cable length left to be routed in industry standard workman like manner, from the point of entry into the systems room, to the equipment rack or backboard, then down to the floor plus three (3) feet.

7. Telecommunications Outlets: At the TO's, the four 4-pair CAT6 cables shall terminate with a minimum of eight (8) inches of spare cable length.
8. Install all cables no closer than 12" from any wire/cable installed for Premise Distribution System, power system cable/raceway, or fluorescent/ballasted light fixtures.
9. All PDS cable shall be installed in the appropriate raceway.
10. Provide protection for exposed cables where subject to damage.
11. All cables in systems rooms shall be routed in overhead cable ladder racks and dropped into the appropriate racks utilizing transition pans. All cables shall be properly secured to the cable tray, racks, or cabinets.
 - a) All fiber cable shall be routed in raceway specifically designed for fiber, and separate from copper cables.
12. Cables shall be terminated to preserve wiring order consistently across all termination (jacks, patch panels, connector blocks and patch cords).
 - h. Ensure consistency. Corrections will be made at no additional cost to the Owner.
 - i. Install appropriate cable to match application, i.e., plenum, riser, etc. All cables shall bear CMP and/or appropriate marking for the application in which they are installed.
 - j. Cables/raceways routed through rated walls; floors and assemblies shall be routed via appropriate fireproofing system as approved by UL.
 - k. Label cable per Airport Standard Voice and Data Infrastructure Cable and Pathways Labeling Format documentation. This labeling/identification shall be fully documented in as-built drawings.

3.5 TESTING

- a. No fiber, copper, or other metallic cable shall be put into use without being successfully tested and the test results accepted as submitted by the Project Engineer of record.
- b. Perform all testing where necessary or specified to assure a fully functional system. Repair or replace and retest components that fail performance standards.
- c. Test all cables.
 1. Provide all cable test results digital format.
 2. Test instrument data fields shall exactly match PDS component labeling, I.E. Telecommunication Outlets, fiber LIUs, etc., provide exact source/destination information for all media tested.
- d. Provide system verification and acceptance documentation signed and dated by the installer.

1. This documentation shall include test measurements and system calibrations performed for the entire system.
 2. Sample system operations shall also be performed with actual hardware or using Contractor provided test equipment and documented to verify that the system is operational and ready for acceptance.
 3. This shall also establish the baseline performance of the system.
- e. Copper Category 6 Testing:
1. Every wire and connector pin for each horizontal cable run from Communications Room(s) to a Telecommunication Outlet (TO) shall be tested at both 10 MHz, 100 MHz and 155 MHz for Category 6 rated operation:
 - a) Continuity on each pin
 - b) Correct pin-pair orientation (wiremap)
 - c) Propagation Delay (100 m)
 - d) Skew (100 m)
 - e) Near end crosstalk (NEXT value)
 - f) Power Sum Near End Crosstalk (PSNEXT)
 - g) dB loss (attenuation)
 - h) Equal Level Far End Crosstalk (ELFEXT)
 - i) Power Sum Equal Level Far End Crosstalk (PSELFEXT)
 - j) Return loss
 - k) Cable length
 - l) Presence of AC voltage
 - m) The Category 6a cable shall be tested for the conformance to the specifications of EIA/TIA 568-A Category 6 and TIA SP-4196 Draft Addendum 5 to EIA/TIA 568-A.
 - n) Should UTP cable type in project be changed to make use of updated cable technologies, testing of cable shall conform to latest industry standard and manufacturer's testing requirements to ensure cable has been correctly installed and is operating to specification.
 2. All backbone and horizontal Category 3 cable and all cables of any type run between Communications/IT Rooms or to Telecommunication Outlets shall be tested for continuity and performance.

- a) Backbone Level 3 cable shall be tested for proper termination positions in punch down blocks (wiremap).
- b) All backbone cabling shall be tested using RJ45 to 110 connector or other adapters as necessary to provide wiremap and performance test results.
- c) Backbone Level 3 cable shall be tested to demonstrate Category 3 transmission capability.
- d) Miscellaneous cables: all cables not specifically mentioned here shall be tested per manufacturer's recommendations to verify correct installation and operation.
- e) Test results shall be submitted for all Level 3 cables.
- f) Test results shall be submitted for all miscellaneous cables.

3.6 DEMONSTRATION/FINAL ACCEPTANCE

- a. Upon completion of the aforementioned tests and before system commissioning and final acceptance, actual voice and data testing shall be performed.
- b. The tests may be performed with existing equipment, if in place, or using contractor provided equipment or test equipment.
- c. The tests shall be witnessed by the Contractor, the Engineer of Record and the Architect of Record.
- d. Demonstrate system to designated Owner personnel as required by applicable sections of these specifications.
- e. All pull-box covers to be removed so Owner can inspect for proper installation of cable and labels.
- f. Provide detailed operation and maintenance instruction and training.
- g. Use submitted operation and maintenance manual as reference during demonstration and training.

END OF SECTION 27 10 00

SECTION 28 13 53 - INTERCOM SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

- a. Hands-free/handset color video intercom security system.

1.2 RELATED SECTIONS

- a. Division 27.

1.3 REFERENCES

- a. American National Standards Institute (ANSI/TIA/EIA) 568 - Commercial Building Telecommunications Cabling Standard.
- b. International Organization for Standards (ISO) 9001:2000 - Quality Management Systems - Requirements.

1.4 SYSTEM DESCRIPTION

- a. Intercom shall provide a large 7-inch touch screen monitor for clear visitor identification and easy operation control.
- b. Intercom shall be installed at a maximum of 4 door locations and connected to a maximum of 8 inside locations with internal communication between stations. Connection to and integration of CCTV cameras for surveillance capabilities shall be available.
- c. The system shall be hard wired and constructed with a 2-wire communication system for the door stations and a Cat5e/6 communication system for the video locations system.
- d. Functional Components: As indicated on the drawings or as required to complete system.
 1. Master Station.
 2. Sub Master Station:
 3. Video Door Station:
 4. Power Supply:
- e. System Design: Provide system layout as follows.
 1. Provide Station-to-Station Wiring: Directly connect a master station to a sub master station.
 - a) Maximum distance of farthest sub master from master station: 980 feet (300 m), cumulative.

- b) Maximum distance between sub master stations in station-to-station wiring: 98 feet (30 m) when 3 stations are powered off 1 power supply, or 165 feet (50 m) when 2 stations powered off of 1 power supply.

1.5 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 methods.
- b. Shop Drawings: Submit the following:
 - 1. Wiring Diagrams: Indicate wiring for each item of equipment and interconnections between items of equipment.
 - 2. Include manufacturer's names, model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.
- c. Installation and Operation Manuals:
 - 1. Submit manufacturer's installation and operation manual, including operation instructions and component wiring diagrams.
 - 2. Provide detailed information required for Owner to properly operate equipment.
- d. Warranty: Submit manufacturer's standard warranty.

1.6 QUALITY ASSURANCE

- a. Manufacturer Qualifications: ISO 9001:2008 certified company.
- b. Installer Qualifications: Factory trained and experienced with system installations of scope and size required for the Project.

1.7 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: Store materials in clean, dry area indoors in accordance with manufacturer's instructions.
- c. Handling: Protect materials during handling and installation to prevent damage.

1.8 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.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- a. Acceptable Manufacturer: Aiphone Corp.
- b. Approved Equals.
- c. Requests for substitutions will be considered given they meet the requirements of this specifications.

2.2 HANDS-FREE/HANDSET COLOR VIDEO INTERCOM SYSTEM

- a. Master Station: JP-4MED 7 inches (180 mm) Digital PTZ Video Master Station with Memory.
 1. The JP Series shall accommodate up to 4 Door Stations and 8 Master Stations in a single system.
 2. Provide icon driven One Touch Hands Free operation. Touch the screen to communicate with visitors using the built-in microphone and speaker or use the handset at any time during conversation for privacy.
 3. Operation: From Master Station. Provide the following.
 - a) Room Call: Touch screen icon to call a single sub master station or all sub master stations simultaneously.
 - b) Play: Touch screen icon to play recorded images from door stations.
 - c) Settings: Touch screen icon to program settings and adjustments.
 - d) Security: Touch screen icon to activate the security mode or to change security settings.
 - e) Monitor: Touch screen icon to monitor a door station or sub master station.
 - f) Option: Touch screen icon to activate the connected external device(s).
 4. Available Functions During Monitoring: Provide the following.
 - a) Pan-Tilt-Zoom/Wide camera control.
 - b) When monitoring is started, an image shall be shown in wide mode. Pan

and Tilt and adjusting images shall be possible from the Master Station.

- c) Door release shall be possible from the Master Station.
- d) Volume control shall be possible from the Master Station.
- e) Manual recording shall be possible from the Master Station.
- f) If a CCTV camera is connected instead of a video door station at entrance, provide audio monitoring and communication via the GT-D.

5. Physical Characteristics:

- a) Power supply: DC 24V (from power supply).
- b) Current Consumption: 390 mA.
- c) Communication: Handset - Simultaneous communication.
- d) Communication: Hands-free - Auto-voice actuation.
- e) Ambient Temperature 32 degree F to 104 degree F (0 to 40 degrees C).
- f) Monitor: 7 inches (180 mm) color LCD monitor.
- g) Mounting: Wall mount.
- h) Mounting: Desk mount with MCW-S/B.
- i) Electrical box: 3-gang box
- j) Material: Flame resistant ABS resin.
- k) Color: White.
- l) Dimensions: 5-11/16 inches H x 10-1/16 inches W x 1-7/8 inches D (145 mm by 255 mm by 48 mm).
- m) Weight: Approx. 1.74 lbs (790 g).

b. Room Station (Sub Master Station): JP-4HD.

- 1. Provide icon driven One Touch Hands Free operation. Touch the screen to communicate using the built-in microphone and speaker or use the handset at any time during conversation for privacy.
- 2. Physical Characteristics:
 - a) Power supply: DC 24V (from power supply).
 - b) Current Consumption: 200 mA.

location, with which recording frequency increases to 4 pictures per second for up to 10 seconds per call.

- c) Provide documentation of outside disturbances by manually recording them at any time.

5. Physical Characteristics:

- a) Operating Temperature: 14 degrees F to 140 degrees F (-10 to 60 degrees C).

- b) Dimensions:

1) JP-DV 6-13/16 inches x 3-7/8 inches x 1 inch (173 x 98 x 25 mm).

- c) Power Supply: DC 24V (from master station).

- d) Current Consumption: 90 mA.

- e) Mounting:

1) JP-DV: Surface mount direct to surface.

- d. Power Supply: PS-2420UL, 24V DC Power supply.

- e. Call Extension Speaker: IER-2, Call extension speaker

PART 3 EXECUTION

3.1 EXAMINATION

- a. Examine areas to receive integrated security and communication system.
- b. Notify Architect of conditions that would adversely affect installation or subsequent use.
- c. Do not begin installation until unacceptable conditions are corrected.

3.2 PREPARATION

- a. Verify the following compliance before starting installation.
 - 1. All units, door stations, are designed for indoor use only. Do not use outdoors.
 - 2. The unit turns inoperative during power failure.
 - 3. In areas where broadcasting station antennas are close by, intercom system may be affected by radio frequency interference.
 - 4. Keep the intercom wires at least 1 foot (30 cm) away from strong electrical wiring (AC 100-240 V) including, in particular, wiring for inverter electrical appliances. Noise and malfunction could result.

5. Keep the unit more than 3.3 feet (1 m) away from radio or TV set.
6. If a strong light shines on the main unit screen, the picture may turn white or only silhouettes will be visible.
7. Other manufacturer's devices (such as sensor, detectors, door releases) used with this system, comply with the manufacturer's installation requirements.
8. The LCD panel is manufactured with very high precision techniques, inevitably will have a very small portion of its picture elements always lit or not lit at all. This is not considered a unit malfunction. Please be aware of this in advance.

3.3 INSTALLATION

- a. Install integrated security and communication system in accordance with manufacturer's instructions at locations indicated on the Drawings.
- b. Mount equipment plumb, level, square, and secure. For video entrance stations and video door stations, comply with manufacturer's design requirements to provide optimum picture quality of station monitoring.

3.4 SET-UP AND ADJUSTING

- a. Adjust integrated security and communication system for proper operation in accordance with manufacturer's instructions.

3.5 DEMONSTRATION AND TRAINING

- a. Demonstration:
 1. Demonstrate that integrated security and communication system functions properly.
 2. Perform demonstration at final system inspection by qualified representative of manufacturer.
- b. Instruction and Training:
 1. Provide instruction and training of Owner's personnel as required for operation of integrated security and communication system.
 2. Provide hands-on demonstration of operation of system components and complete system, including user-level program changes and functions.

3. Provide instruction and training by qualified representative of manufacturer.

3.6 PROTECTION

- a. Protect installed integrated security and communication system from damage during construction.

END OF SECTION 28 13 53

SECTION 283100 – FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

a. The general provisions of the Contract and the requirements of Section COMMON WORK RESULTS FOR ELECTRICAL apply to the Work specified in this Section.

1.2 SUMMARY

a. Provide a stand-alone fire alarm system independent of any other building automation, energy control, lighting, security or other system.

b. Fire Alarm LAN:

c. Provide fire detection and alarm system. The system shall include, but not be limited to, all control equipment and control panel nodes, power supplies, signal initiating and indicating devices, conduit, wire, fittings, and all other accessories required to provide a complete and operational system.

1. Network communications protocol shall be LAN technology with true peer-to-peer communication capability among all components of the fire alarm system. Systems providing central point polling and processing or master/subordinate relationships are unacceptable.

d. Provide 100% addressable initiating devices. All smoke detectors shall be intelligent analog sensors.

e. Fire Alarm System Remote Annunciator Panels:

1. Provide remote annunciator panels so the fire alarm system can be responded to from other locations besides the main fire alarm control panel.

1.3 QUALITY ASSURANCE

a. Authority Having Jurisdiction:

1. General: The system shall comply with all applicable Codes, Ordinances and Standards as interpreted and enforced by the local authority having jurisdiction.

b. NFPA:

1. General: Comply with applicable requirements of latest NFPA Standards, including the following.
2. NFPA 70: National Electrical Code. The system shall comply with NFPA 70, National Electrical Code, 2017, including: 1) Article 760.
3. NFPA 72-2016: National Fire Alarm Code

4. NFPA 90A-2018: Standard for the Installation of Air Conditioning and Ventilating Systems.
5. NFPA 101-2018: Life Safety Code.

c. UL:

1. General: The entire system shall be UL listed.
2. UL 268: Smoke Detectors
3. UL 864 9th Edition: Control Units
4. UL 464: Horns
5. UL 1424: Cables

d. IEEE: The fire alarm system includes solid state electronic components. Therefore, the equipment manufacturer shall provide certification that all such equipment is internally protected from, or can withstand, power line surge voltages and currents as specified in Table 3, Location Category A3 High Exposure of ANSI/IEEE Standard C62.41-1991 (formerly IEEE Standard 587).

e. NECA:

1. Install electrical distribution equipment in accordance with National Electrical Installation Standard (NEIS) published by the National Electrical Contractors Association (NECA).
2. Install fire alarm system in accordance with NECA 305-2010 National Electrical Installation Standard (NEIS) for Fire Alarm System Job Practices.

1.4 SUBMITTALS

a. Qualification Data:

1. Submit copy of authorized distributor agreement or other proof showing first date of product representation to verify five year minimum requirement. Documentation shall be on fire alarm system manufacturer letterhead.

b. Product Data:

1. Duct Detectors: Submit manufacturers published data to show UL listed velocity range and temperature and humidity tolerance ranges. Submit a proposed detail for a typical duct detector mounting arrangement. Submit similar data for open air detectors when proposed for use in open, non-ducted return air streams.
2. Provide functional information and instructions on system operation.
3. Provide copy of U.L. file card or proof that system is listed by U.L.

4. Indicate the U.L. listing, the U.L. classification, and NEC insulation type used for each type of wire to be used in installation of fire alarm and communications system.
 5. Mark catalog page or other cable manufacturer published data to show fire alarm wire is shielded. If unshielded fire alarm wire is proposed for signaling line circuits, initiating device circuits, and notification appliance circuits, include fire alarm manufacturer's published installation recommendations to verify that unshielded wire is suitable for this installation.
 6. Provide factory catalog pages, mounting details and specification sheets for all fire alarm system components and rough-in boxes.
 7. Battery sizing calculations.
 8. Wire sizing calculations to prove maximum 3% voltage drop at all ac voltages and maximum 10% voltage drop at all dc voltages. Maximum dc voltage drop may be increased to 15% if recommended by fire alarm manufacturer and dc devices stay within UL-listed voltage tolerances.
 9. Submit published test data for each type of speaker and horn. Indicate UL-listed dBA values for each wattage tap available on speaker/horn transformer, based on the proposed alarm system voltage. Speaker dBA values shall be UL-reverberant room test values and not anechoic-chamber test values.
 10. Strobes: Submit manufacturer data to show strobe operating currents, stating both normal at full circuit voltage and UL Max over the strobes listed voltage range. Submit candela curves to illustrate compliance with ADA and UL 1971. Certify that strobe maintains minimum flash rate over entire range of strobe listed operating voltage.
 11. UL 864 9th Edition: Submit proof that fire alarm control panel is listed under 9th edition of UL 864. Submit letter from UL to panel manufacturer authorizing use of UL 9th edition UL-listing label. If UL letter is pending completion of re-listing testing and equipment review by UL, then submit letter on panel manufacturer's letterhead stating schedule to receive re-listing under 9th edition.
 12. Fire alarm manufacturer's recommended wire type for signaling line circuit, initiating device circuits and notification appliance circuits. Indicate shielded or unshielded, twisted pair, distance limitations, and other installation requirements.
- c. Shop Drawings:
1. Only control panels and devices are shown on Contract Drawings. Specific wiring between panels, devices and equipment may not be shown. Submit for review drawings depicting complete system configuration. Show all proposed risers, appliances, components, wiring, conduit, and installed locations of complete system.
 2. Provide installation floor plans to locate all devices. Submit wiring diagrams of the complete Fire Alarm System. Wiring diagrams shall include wire and raceway sizes, fire alarm control panels, communication panels, riser wiring and associated raceway

- sizes, appliances and point to point wiring details, connections and terminal identification.
3. Note candela rating at the symbol for every ADA strobe on the fire alarm floor plans.
 4. Indicate proposed locations of all Fault Isolating Modules (FIM) in Signaling Line Circuit(s) used for intelligent, addressable points.
 5. Show locations on floor plans for all fire alarm auxiliary relays.
 6. Provide manufacturer's drawings showing all dimensions (height, width, and depth) for all cabinets used to house system components.
 7. Detailed line drawing or other rendering of a typical manual pull fire alarm box. Show the reset lock in the front face, not the side, of the pull box.
 8. Provide a detailed drawing of the Fire Alarm Control Panels layout indicating the exact arrangement of all annunciators, including expansion capacity.
 9. One-line diagram showing location and size of all required line-voltage power branch circuits for entire fire alarm system.
 10. Note candela rating at the symbol for every ADA strobe notification appliance on the fire alarm floor plans.
- d. Closeout Submittal: Provide manuals. Include a copy of the completed Installation Certificate in each manual.

1.5 FUNCTIONS

a. Alarm System Automatic Functions:

1. Upon the operation of any manual pull station, sprinkler flow switch, or detector:
 - a) Sound an audible alert signal throughout the facility.
 - b) Simultaneously activate all flashing visual alarm assemblies associated with audible indicators.
 - c) Activate a means to automatically transmit zone specific alarm, trouble and supervisory signals to an approved off-site central station service for supervising station. Provide connection to building's communication network for monitoring at off site location.
2. All alarm signals shall continue sounding and annunciator(s) shall remain lighted until the alarm-acknowledge switch is depressed. The alarm signals shall then stop, but the annunciator shall remain lighted until the system is reset.
3. Acknowledging of any alarm signal shall not interfere with the re-activating of the alarm signals upon an alarm from another zone.

4. Alarm Verification:

- a) The main fire alarm control panel shall have a U.L. Listed alarm verification feature for smoke detection alarm verification circuits. Alarm verification shall be per initiation device, not just for the total system. Alarm verification per U.L. shall apply only to open area (spot-type) smoke detectors, even when other device types are installed on the same initiating circuit. Any alarm from the same detector or any other initiating device that occurs during the confirmation period shall result in immediate alarm from the control unit.
- b) The alarm verification feature is not permitted to be enabled for the initial system installation unless conditions or occupant activities that are expected to cause nuisance alarm are anticipated in the area that is protected by smoke detectors. Enabling of the alarm verification feature shall be protected by password or limited access.
- c) The current status of the alarm verification feature shall be shown on the record of completion for the fire alarm system.
- d) Comply with additional criteria in 2010 NFPA 72 section 6.8.5.4.

1.6 INITIATING AND SUPERVISORY ZONES

a. General:

- 1. Minimum zoning function requirements shall be as outlined below. Provide software programming or additional zoning required to properly accomplish the functions specified in Article FUNCTIONS or required by Codes. The zones specified in this Article apply to the initiating and the supervisory functions. Each initiating zone shall be provided with an associated trouble alarm. In addition, provide separate supervisory zones as indicated. The use of the term "zone" shall be taken to mean an initiating zone unless otherwise identified. Alarm and trouble indicators for all zones (including expansion zones) on each floor shall be conveniently grouped together in the Fire Alarm Control Panel(s). Supervisory zones may be grouped or combined with initiating zones as appropriate to the function.

b. Provide 100% addressable devices so that all initiating points are uniquely identified.

c. Smoke Detectors: All smoke detectors shall be addressable and intelligent, analog sensors.

1.7 ALARM NOTIFICATION AND EMERGENCY COMMUNICATION ZONES

a. Provide one general alarm zone to notify the entire building for any alarm condition. Also provide horn and strobe coverage for other areas shown on plans and as required by LAHJ-Local Authority Having Jurisdiction, local Inspectors, Building Officials and Codes. Appliances shall be sufficient to produce required sound pressure level and associated visual notification. Alarm notification/public address zoning for these spaces shall generally coincide with the set of initiation addresses or points.

1.8 EXTRA MATERIALS

a. General: Provide extra materials for Owner's use. All parts shall be identical to the corresponding components of the installed systems.

b. Package in suitable cartons. Identify by nameplates, stamping or tagging.

c. The following spare parts and accessories shall be provided:

2 copies of the reset key for manual pull stations

3 spare fuses for each fuse type in the system

(1) spare strobes of each candela rating installed

(3) of installed quantity of automatic detectors, including bases, of each type installed

1.9 MAINTENANCE THROUGH PROJECT WARRANTY PERIOD

a. General: Provide a one-year maintenance agreement. Reference Section COMMON WORK RESULTS FOR ELECTRICAL for additional requirements. Provide total fire alarm system inspection, testing and maintenance for one year. Comply with procedures of Inspection, Testing and Maintenance of NFPA 72, National Fire Alarm Code. Clean detectors and other components as required. Replace broken, defective or otherwise non-operating components and wiring. Maintain and update system software and point-to-point diagrams to mirror actual device installations, building configuration, schedules, programmed responses and other system functions. Keep permanent records in format similar to forms given in NFPA 72. Give Owner hardcopy and CD with electronic copy of all records quarterly plus annual summary report at end of year through warranty period.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

a. Acceptable Manufacturers:

1. Edwards Fire Alarm

2. Notifier brand from Notifier-A Honeywell company

3. Simplex brand from Tyco Fire & Security.

4. Approved Equal

b. The entire system shall be furnished by one manufacturer. Only primary product of each manufacturer, bearing that manufacturers nameplate, shall be furnished. Subsidiary companies or other brand-names that may be owned by a given manufacturer shall not be substituted or furnished in place of actual named manufacturer. Private label product that may be OEM/manufactured by one of the acceptable manufacturers but is UL-listed and sold by a different manufacturer under different brand name is not an acceptable equivalent fire alarm system.

2.2 FIRE ALARM CONTROL PANEL

a. General: A complete Fire Alarm Control Panel shall be installed in the ground floor Fire Command Center. The panel shall be wall mounted and shall contain -- but not be limited to -- the following basic components and systems:

1. Fire detection and annunciator panels including supervisory indications.
2. A two-way selective telephone communications system for communication between the command center and all remote firefighter telephone jacks and telephones.
3. Notification appliance circuit controls for building evacuation signals.
4. Controls for shutting down air conditioning and ventilation fans.
5. Central Station Service: Provide a Digital Alarm Communicator Transmitter (DACT) per NFPA 72 section 8.5. Connect primary and secondary phone lines for automatic reporting to remote supervising station as required by NFPA 72 chapter 8. Provide Ethernet communication module as required for communication on network for offsite monitoring.

b. Construction:

1. Modular and of dead front construction.
2. Controller shall be a microprocessor and capable of future expansion.
3. Alarm initiating circuits shall meet the requirements of NFPA 72 for limited energy applications and functions.
4. Control panel functions may be grouped into more than one panel.
5. Panels shall be surface/flush mounted.

c. Power Sources:

1. Primary Supply: The power supply shall supply sufficient power to sound all signals and light all visual notification appliances simultaneously, and shall operate from a two-wire, single phase 120Vac source from the power system. Size power supplies as necessary for both appliance full load and turn-ON inrush currents. Include 25% spare capacity in addition to the full load of all installed notification appliances.
2. Battery Backup: The battery backup shall automatically supply energy to the whenever the primary supply is unable to provide the minimum necessary operating voltage. The batteries shall provide operating and supervisory power for a minimum period of 24 hours, and shall then be capable of operating all alarm notification appliances for at least 5 minutes. In addition, the battery power supply for emergency alarm communications service shall be sized for operating the system under normal maximum operating load for 24 hours and then for fifteen (15) minutes at maximum connected load. The battery system shall be supervised for both overcharging and

low battery. The power supply shall include a properly sized automatic battery charger. Charger shall be dual-rate (full and trickle) and temperature compensated.

d. Alarm Initiating Circuits:

1. Provide Class B/Style B initiating device circuits (IDC).

e. Alarm Notification Circuits:

1. Notification: Provide Class B/Style Y notification appliance circuits (NAC). Provide separate strobe NAC if operation of the voice, tone or horn signals would impair proper operation of any strobes installed on a common NAC.
2. Distinctive Signals: Audible signal appliances for a fire alarm system shall produce signals that are distinctive from other similar appliances used for their purposes in the same area. The distinction among signals shall be as follows:
 - a) Fire alarm signals shall be distinctive in sound from other signals and this sound shall not be used for any other purpose.
 - b) Supervisory signals shall be distinctive in sound from other signals and this sound shall not be used for any other purpose except to indicate a trouble condition. When the same sound is used for both supervisory and trouble signals, distinction between signals shall be indicated by visible means.
 - c) Fire alarm, supervisory, and trouble signals shall take precedence over all other signals.

f. Non-Lock Walk Test: The system shall include a special non-lock "walk test" mode. The walk test mode can be initiated by loop, software zone, or globally as field selected. The following reports shall be capable of being generated:

1. General results of all walk tested devices.
2. Report all un-programmed devices installed.
3. Report all programmed devices not installed.
4. Report all devices not tested.

g. Automatic Detector Test: The system shall include a special automatic detector test feature which permits reading and adjustment of the sensitivity of all intelligent detectors from the main control panel. An automatic detector test shall occur automatically each twenty-four-hour period or be initiated manually from the FACP as desired. In addition, the automatic test feature shall also permit the functional testing of any "intelligent" detector or addressable interface device individually from the main control panel. Automatic detector test sequencing shall be terminated upon receipt of an actual alarm condition.

h. Software and Firmware Control:

1. All software and firmware provided with a fire alarm system shall be listed for use with the fire alarm control unit.
2. A record of installed software and firmware version numbers shall be maintained at the location of the fire alarm control unit.
3. All software and firmware shall be protected from unauthorized changes through the use of "access levels".
4. All changes shall be tested in accordance with NFPA 72 procedure for Reacceptance Testing.

i. Field Programming:

1. The system shall be 100% field programmable without the need for PROM programmers, and shall not require replacement of memory integrated circuits chips. Systems requiring factory programming/re-programming or field replacement of memory chips shall not be acceptable.
2. Programming shall be possible only after entering an appropriate and pre-selected password security code.
3. All programs shall be stored in non-volatile electronic memory.
4. Software Compare: Programming software shall include a "compare" feature, also called a "Difference Report". Compare shall test program after any changes and report all changes, both intended and inadvertent. Software shall furnish file for hardcopy printout. Printed report shall show all program steps and identify all changes. Also provide software for "Where-Used Report" that will identify where each device, appliance and control output is used in the system software, i.e. in what lists and in what equations. Include complete descriptions of these and any other software archival and testing programs.

j. Event History: The main fire alarm panel shall have memory to store system events with a minimum event history of 10% of total system device capacity. Event history shall include all system alarms, troubles, operator actions, unverified alarms, circuit/point alterations, and component failures. Events shall be time and date stamped. Memory shall be non-volatile. Access to history buffer shall be secured via password.

k. Alarm Verification:

1. The main fire alarm control panel shall have a U.L. Listed alarm verification feature for smoke detection alarm verification circuits. Alarm verification shall be per initiation device, not just for the total system. Alarm verification per U.L. shall apply only to open area (spot-type) smoke detectors, even when other device types are installed on the same initiating circuit. Any alarm from the same detector or any other initiating device that occurs during the confirmation period shall result in immediate alarm from the control unit. Alarm verification shall NOT apply to heat detectors, linear beam or duct smoke detectors, nor to any "cross-zoned" detection circuits.

2. The alarm verification feature is not permitted to be enabled for the initial system installation unless conditions or occupant activities that are expected to cause nuisance alarm are anticipated in the area that is protected by smoke detectors. Enabling of the alarm verification feature shall be protected by password or limited access.
3. The current status of the alarm verification feature shall be shown on the record of completion for the fire alarm system.
4. Comply with additional criteria in 2002 NFPA 72 Section 6.8.5.4.

2.3 MANUAL PULL FIRE ALARM BOXES

a. General: Provide non-coded, double action, non-break-glass type, semi-recessed manual fire alarm boxes. Each pull box shall have an addressable module programmed to provide a unique address.

b. Color: Red

c. Key Reset: Resetting fire alarm box shall require inserting a key and manually closing the pull box. The lock shall be in the front face of the pull box. Locks set into the side of the pull boxes are unacceptable.

2.4 HORNS

a. General: Horns shall be listed for fire protective signal service under U.L. Standard 464 Category (ULSZ) Audible Signal Appliances and meet the requirements of the Life Safety Code. Horns shall be suitable for semi-flush wall or flush ceiling installation. Include mounting plate and back box.

b. Sound Pressure Level:

1. General: All sound pressure levels shall be measured on the "A" weighted scale at a distance from horn of ten feet on the centerline axis of the horn output distribution pattern.
2. Maximum: 110 dBA.
3. Minimum Differential: 15 dBA greater than average ambient sound level within any given room or space. The average ambient sound level may be taken as 55/55/45/35 dBA as given in NFPA 72-Appendix Ch. 6-3.1 for a assembly/business/educational/residential occupancy.
4. Code 3 Temporal Pattern: Set horn for 3-pulse temporal pattern. All horns on a single building floor shall be synchronized to all sound together.

c. Color: Provide red horns where installed in a ceiling or when indicated on Drawings; otherwise red. Color shall be the solid body color of the high-impact thermoplastic horn.

d. Type: Similar to Notifier/System Sensor SpectrAlert Advance Series, Gentex Corp. Commander3 GEH Series electronic horn (www.gentex.com 800-436-8391), Cooper Wheelock Multitone Electronic Horn MT Series, or approved equal.

2.5 HORN WITH STROBE ASSEMBLIES

a. General: Where indicated on the Drawings as a combination unit, horn and strobe shall be housed together and have a common cover plate. Unit shall include appropriate back box and trim for semi-flush wall mounting.

b. Horns: As specified above for HORNS.

c. Strobe: Refer to paragraph STROBES.

d. Finish: Red high-impact thermoplastic.

2.6 STROBES

a. General: Provide independent strobe without audible device where indicated on the Drawings. Unit shall include appropriate back box and trim suitable for semi-flush wall mounting.

b. Strobe: Shall be U.L. Listed per Standard 1971. Provide a strobe type visual signal which utilizes a Xenon flash-tube. Strobe shall have a clear lamp cover set in a base imprinted with the word "FIRE". Lettering shall be arranged appropriately for wall or ceiling mounting, as applies to specific device location.

c. Flash Rate: Minimum 1 Hz and maximum 2 Hz. Minimum flash rate and candela intensity shall be maintained over the regulated voltage range of strobe. Strobe manufacturer shall guarantee that published strobe current is not exceeded over the regulated voltage range. Strobe operating voltage shall be 24 Volts dc.

d. Flash Synchronization: Provide means of synchronizing strobe flashing when more than two strobes in a room or space are visible within the field of view. All such strobes shall flash simultaneously. Provide dedicated power supply or other means to assure strobe synchronization. Example: long corridor with more than two strobes; perimeter of an auditorium or other large room; large common area with more than two strobes.

e. Power Supply: Strobe dc power supply shall be filtered and regulated. Power supply with ac input and Full Wave Rectified dc output without filtering and regulation is unacceptable. Size power supplies to accommodate both the strobe UL-listed RMS operating current and turn-ON inrush current.

f. Effective Intensity:

1. Corridors Up To 20 Feet Wide: Combination 15/75 Candela. ADA minimum 75 candelas on perpendicular axis. NFPA/UL minimum 15 candela in UL-pattern for public mode service.

2. Rooms Not Exceeding 20 Feet Length or Width: Combination 15/75 Candela. ADA minimum 75 candelas on perpendicular axis. NFPA/UL minimum 15 candela in UL-pattern for public mode service.
3. Rooms Exceeding 20 Feet Length or Width: Candela and spacing shall be per NFPA 72 Figure and Tables for Wall-Mounted and Ceiling-Mounted Visible Appliances. Candela shall be highest value of 185, 110, 75, 60 or 30 allowed by NFPA Tables in order to install the fewest number of strobes per room.

g. Color: Red.

2.7 HEAT DETECTOR

- a. Rate of Riser with 15F per minute rate of rise alarm part.
- b. Electronic Addressing
- c. 50 Foot Spacing. Space reduced per mounting height reduction per NFPA 72 within hangar.
- d. Environment: 32F to 100F
- e. Physical: High Impact Polymer, Colored White
- f. Mount to standard Sized junction boxes. Quantity as indicated on plans.

2.8 AUXILIARY CONTROL RELAYS

- a. Provide SPDT, 8 amp, 120 VAC relays in NEMA 1 enclosures for mechanical fan control, smoke damper and fire/smoke damper activation, and other required control functions. Relays shall be similar to Notifier MR-101/C.
- b. Addressable: Similar to EST Control Module or Notifier FRM-1 Control Module.
- c. Install each relay into a metal box with cover. Where installed above inaccessible ceiling, install box with cover flush in ceiling or provide an access panel to concealed box. Example: hotel guest room with hard ceiling in the room entry vestibule.

2.9 INTELLIGENT DEVICE PROGRAMMER/TESTER

- a. Furnish as a part of the installed system, a UL listed programmer and tester.
- b. Features:
 1. The programmer shall be portable with a carrying case with cover, latch and handle and internal charging supply and rechargeable battery sufficient for four hours of use before requiring recharging. Battery conservation circuitry shall shut off power to the device should no keyboard activity take place for five minutes.

2.10 REMOTE LCD ANNUNCIATORS

a. Remote Fire Alarm Annunciator (FAA): Provide remote Liquid Crystal Displays (LCD) alpha-numeric annunciator, similar to Notifier LCD-80 to annunciate all system events and duplicate the displayed status at the main FACP. The annunciator shall be a backlit eighty-character LCD display and operate via the system RS485 or RS232 serial output terminal from the main FACP. The LCD display shall automatically illuminate upon receipt of an alarm or trouble condition. The unit shall operate on 24VDC power and function during system power failure via standby batteries. The remote LCD annunciator shall include:

Integral time-date clock	System reset
Time-date select switch	System silence
Time-date/contrast adjust	System acknowledge
Display/step switch	Integral trouble buzzer

b. Annunciator shall upon command display the first system alarm, last alarm, and system alarm count. The unit shall be equipped with an integral lamp test feature. The unit shall be (flush)(surface) mounted where shown.

c. Each unit shall include control switches for System Acknowledge, Signal Silence and System Reset.

d. Provide a smoke detector at each remote annunciator panel; install within the distances allowed by NFPA 72 rule 4.5.5.

2.11 FIRE ALARM MC CABLE

a. Fire alarm wiring that is required to be in raceway shall be installed in one of the following methods:

1. rigid galvanized steel conduit,
2. EMT or
3. fire alarm MC cable.

b. Fire Alarm MC:

1. Fire alarm MC cable shall be AFC Cable Systems type Fire Alarm/Control™ MC cable or approved equal (AFC 800-757-6996/ www.afcweb.com).
2. Fire alarm MC cable shall have red-stripe color code on exterior. Red stripe shall be permanent color applied by original cable manufacturer.
3. Fire alarm MC cable shall have dual listing by UL as both MC cable and as Fire-Protective Signaling Cable (Type FPL).

4. Fire alarm MC cable shall not be installed for vertical fire alarm risers. Fire alarm MC cable shall only be installed for horizontal fire alarm branch wiring. A given run of MC shall serve only devices on that floor. Example: Fire alarm wiring for smoke control systems per UBC 905.9.2 may be fire alarm MC cable for horizontal wiring on any single floor.
5. Install fire alarm MC with Bridgeport Fittings Model 570-RI color-coded red fittings or approved equal. Note that red fitting allows fire alarm MC to be identified from inside the outlet box without having to open the wall to view the MC outside of the outlet box.

2.12 KNOX BOX

- a. General: Provide a Knox-Box Rapid Entry System. Key storage box shall be product of Knox-Box, Irvine, CA 800-552-5669 www.knoxbox.com.
- b. UL Listed: Key box shall be UL listed.
- c. Color: Reflective label shall be red for FIRE.
- d. Flush Wall Mount: Provide 3200 Series key storage box. Install flush into wall at 6'-0" to centerline above finished floor. Include Recessed Mounting Kit for masonry construction.

PART 3 - EXECUTION

3.2 INSTALLATION

- c. General: All components shall be completely wired. System shall be fully operable when main power service has failed and the Emergency Generator has assumed emergency system loads.
- d. Main Power Circuit:
 1. Provide dedicated 20-amp, 120 Volt, 2 wire plus green grounding conductor circuit(s) to the Fire Alarm Control Panel. All panelboard directories and circuit disconnecting means shall have red marking and be clearly labeled "FIRE ALARM CIRCUIT". Provide handle lock-on devices on all circuit breakers.
 2. The location of the circuit breakers for all branch circuits serving fire alarm control panels.
 3. Electrical Division shall provide secondary surge arresters at emergency source panelboard(s) serving main power circuit(s). Provide two Square D Class 6671 SDSA 1175, or approved equal, connected for 208Y/120V, 3 phase, 4 wire grounded service protection at each panel.
- e. Raceway:
 1. Provide dedicated raceway for all fire alarm system wiring. Furnish and install fire alarm raceway in accordance with the Section RACEWAY SYSTEMS.

2. Provide dedicated raceway for all fire alarm system wiring in accordance with the Section RACEWAY SYSTEMS, except no raceway shall be required for power-limited low voltage circuits in the following areas:
 - a) Power-limited fire protective signaling circuits in accessible air handling ceiling cavities as described in NEC 300.22 (C), where cable is used that is U.L. Listed as having adequate fire-resistant and low-smoke producing characteristics per U.L. Subject 910. Refer to paragraph titled "U.L." in this section for additional requirements.
 - b) Accessible, non-air handling (static) ceiling cavities with same cable as for air handling ceiling cavities.
 3. Provide raceway in walls even when it is not required in ceiling cavities as outlined above.
 4. Provide raceway for all main trunk cable risers and any riser extending through two or more floors.
 5. Provide raceway above accessible ceiling when ceiling is higher than 11'-0" above finished floor.
 6. Install wiring to duct detectors in flexible steel raceway.
 7. All initiating, indicating and auxiliary control devices shall be mounted on UL listed outlet boxes.
 8. Raceway for fire alarm wiring shall not contain any other wiring.
 9. YELLOW: Spray paint all junction boxes for fire alarm system wiring with yellow paint. Label each box "Fire Alarm".
- f. Cable:
1. Conductor: 98% conductivity, solid copper or stranded copper with maximum of 7 strands. If stranded conductors are used, then a compression lug shall be installed at every end. Wrapping twisted strands at terminal block screw is not acceptable. As an acceptable equivalent, stranded conductors without crimp-on lugs may be terminated into terminal strips of box-lug connectors.
 2. Insulation: A type approved by NEC for the application. All cable shall be U.L. Listed for fire-protective signaling application. Communication, Class 3 or Multi-Purpose cables shall not be substituted for FP cable types.
 3. Size: All conductors shall be sized as prescribed by the system manufacturer, with following minimums.
 - a) Initiating Circuits, Hard-Wired Devices: AWG #18.
 - b) Initiating Circuits, Addressable Devices: AWG #18, shielded twisted pair.

- c) Notification (Indicating) Appliance Circuits, Voice Alarm: AWG #18, shielded twisted pair.
- d) Notification (Indicating) Appliance Circuits, Horns and Bells: AWG #14.
- e) Notification (Indicating) Appliance Circuits, ADA Strobes: AWG #14, shielded twisted pair.
- f) Signaling Line Circuits (SLC): AWG #16, shielded twisted pair.
- g) Provide AWG #16, AWG #14 or larger conductors where required to maintain voltage drop or signal strength within acceptable limits.
- h) If unshielded fire alarm wire is proposed for signaling line circuits, initiating device circuits, and notification appliance circuits, include fire alarm manufacturer's published installation recommendations to verify that unshielded wire is suitable for this installation.

4. Color Coded:

- a) Wiring shall be color coded in accordance with the following scheme without color change in any wire run. Alternate colors or wire markers or designation on wire may be proposed for approval.

Initiating Circuits, General	Red (+)/White (-)
Initiating Circuits, Smoke Only	Violet (+)/Gray (-)
Alarm Notification Appliance Circuits	Blue (+)/Black (-)
Mechanical Equipment Shutdown Circuits	Yellow

- b) Wire color codes shall be maintained through the entire fire alarm system.
- c) Permanent wire materials shall be used to identify all terminations for each circuit.

5. U.L.:

- a) General: Fire-protective signaling cable shall be U.L. listed as non-power limited or power limited as needed to match the output of the fire alarm equipment
- b) Non-Power Limited: Fire protective signaling circuits classified as non-power limited shall use cable listed under U.L. Electrical Construction Materials Directory. Category HNHT, "NON-POWER LIMITED FIRE-PROTECTIVE SIGNALING CABLE". All such cable shall have fire resistance, listing and markings as described in NEC 760-15. Minimum cable marking shall be NPLF as described in UL Category HNHT.
- c) Power Limited: Fire protective signaling circuits classified as power limited shall use cable listed under U.L. Category HNIR, "POWER LIMITED FIRE-

PROTECTIVE SIGNALING CABLE". All such circuits shall be durably marked where plainly visible at terminations to indicate that it is a power-limited fire protective signaling circuit. Refer to paragraph titled "Fire Resistance of Cables" for additional requirements.

- d) Fire Resistance of Cables: Power-limited fire-protective signaling circuit cables shall be U.L. Listed as described in NEC 760-71. All such cable shall bear a cable marking that includes a Type designation as given in NEC Table 760-61. Provide Type FPL except riser cables shall be labeled Type FPLR and plenum cables shall be labeled Type FPLP.
 - e) Circuit Integrity Cable: CI cable shall have the UL classification mark 'CI' as described in UL Category (HNIR) and in NEC 760.81(F) and 760.82 (G); or cable may be UL listed as a electrical circuit protective system under UL (FHIT). CI marking on cable shall be in addition to other fire alarm cable markings; examples—FPLP-CI, FPLR-CI and FPL-CI. The inside conductor pair shall have red and black or other contrasting color insulation. If not color coded, then cables shall be marked RED and BLACK or similar approved text so each conductor inside the cable jacket has unique identification. Insulation jacket shall be low smoke and zero halogen. Where cable must be run through air-handling plenum space, install Type CIC cable in 3/4" EMT with steel set screw fittings, unless CI cable classification allows plenum installation without raceway. CI and CIC cables shall be Belden Safe-T-Line Series CI and CIC cables www.belden.com , Pyro CiC 2-hour fire rated cable by Pyrotenax brand or Raychem CI brand www.tycothermal.com/nec of Tyco Thermal Controls www.tycothermal.com , VITALink® CI brand of Rockbestos Surprenant Cable Corporation www.vitalinkcable.com , or approved equal.
6. Manufacturers: See Section ELECTRICAL WIRING.
- g. Connections of Installation Wiring:
- 1. Connections to Equipment: In accordance with NFPA for monitoring integrity and with the equipment manufacturer's instructions.
 - 2. Connections of installation wiring to alarm initiating devices and alarm indicating appliances shall be monitored for integrity.
 - 3. Interconnecting means shall be arranged so that a single break or single ground fault will not cause an alarm signal.
 - 4. There shall be no wire-to-wire splices. Wire nuts, wing nuts, taped splices, and twisted wires are prohibited from the work for this Project. Terminate all wiring onto screw terminals of appliances, panels or terminal strips in wiring cabinets. Apply a compression lug, similar to T&B Sta-Kon Terminal, to all stranded conductors at terminations or use box-lug terminal strips.
 - 5. All wiring shall be continuous and uncut between control panel, appliances and terminal blocks.

6. Permanently label every wire termination at terminal blocks, fire alarm wiring cabinets and fire alarm control panels.

h. Auxiliary Control Relays:

1. An auxiliary fire alarm relay used to initiate control of fire safety functions shall be located within 3 ft. of the controlled device (NFPA 72 sect. 3-9.2.1). The installation wiring between the fire alarm control panel and the auxiliary fire alarm relay shall be monitored for integrity. Examples: motor controller for smoke control fan, controller for smoke control dampers, power supply for door hold-open devices, power supply for door unlocking devices, etc.
2. Control devices that operate on loss of power (fail-safe) or on loss of power to the auxiliary relay shall be considered self-monitoring for integrity. Smoke dampers that are fail-safe upon loss of power and are wired in parallel on a common power circuit for their motor drives may be controlled with a single relay that interrupts the common power circuit.

i. Strobe Notification Appliance Circuits (NAC):

1. Provide separate strobe NAC if operation of the horn or tone signals, such as a three-pulse temporal fire alarm signal, would impair proper operation of any strobes installed on a shared, single NAC.
2. Provide separate strobe NAC for all strobes required to be synchronized.
3. Install first strobe in each corridor no more than 15 feet from the end of the corridor. Interruptions to the concentrated viewing path of eye-to-strobe caused by doors, elevation changes, or other obstructions shall constitute the end of a corridor.
4. Corridors are defined to be those pathways up to 20 feet maximum in width.
5. Mounting Height: Install strobes so that entire lens is at least 80" above finish floor.
6. Install strobe in every office occupied by two or more persons.
7. Install a strobe in every restroom stall that has full floor to ceiling partition walls.

3.3 PROTECTION OF FIRE ALARM CONTROL UNITS

c. Provide photoelectric smoke detector at the location of each fire alarm control unit and notification appliance circuit power extender when they are installed in an area that is not continuously occupied, per 2002 NFPA 72 rule 4.4.5. Install detector within distances allowed by Appendix text to the NFPA 72 rule.

3.4 FIELD QUALITY CONTROL

c. Acceptance Testing:

1. General: A final inspection of the system shall be rendered by the authorized factory representatives. Final inspection shall include a comprehensive verification audit with

- inspection and test of 100% of all fire alarm system equipment. Audit performers shall have license or certification acceptable to the authority with jurisdiction.
2. NFPA 72: Testing procedures shall be in accordance with NFPA as stipulated for new system acceptance testing. The following paragraphs list minimum verification audit procedures that may require additional work to meet NFPA 72.
 3. Fire Alarm Control Equipment: Make a visual and functional test of all fire alarm control and auxiliary control equipment.
 4. Visual Inspection: Make a visual inspection to establish that all electrical connections and equipment are properly installed and operating.
 5. Fault Simulation: Make a functional fault simulation test on all relevant field wiring terminations to ensure that all wiring is properly supervised.
 6. Notification Appliances: Test 100% of notification appliances to ensure proper function and output level.
 7. Auxiliary Functions: All control panel auxiliary functions such as door holder release, central station connection, elevator capture, smoke damper activation by fire alarm auxiliary relays, and fan control shall be functionally tested to verify proper operation.
 8. Load and Stress Testing: Control panel supervisory and alarm current readings shall be taken to verify that the control panel has the appropriate power supplies and standby batteries to operate the system as required. Three minute general alarm stress tests, both under ac power and standby power, shall be conducted to further ensure complete operation of the system.
 9. Annunciators: All annunciators shall be tested to ensure that each point activates properly and labeling correctly defines the area of alarm.
 10. Fire Alarm Peripheral Devices: All fire alarm peripheral devices shall be functionally tested and the location and testing information recorded for each device.
 11. Initiating Devices - Manual:
 - a) Each manual fire alarm station shall be functionally tested for alarm operation.
 - b) Each manual fire alarm station shall be functionally tested for proper wiring supervision.
 12. Initiating Devices - Automatic:
 - a) Each automatic initiating device shall be activated in accordance with manufacturer's instructions to ensure proper operation.
 - b) Each automatic initiating device shall be functionally tested for proper wiring supervision.

- c) Each automatic initiating device shall be inspected to ensure proper placement and mounting.
- d) Duct Smoke Detectors: Test pressure and velocity of air stream at each detector by method recommended by detector manufacturer. Note that FAN MUST BE RUNNING to cause air flow in order for duct detector to function. Record each detector as pass/fail within detector sensitivity ranges per the UL listing. Correct detectors that fail and retest until they pass. Record the initial pressure differential measured across each duct detector. Test report shall include check-off to certify sampling tube inlet holes are correctly installed facing upstream into air flow.
- e) Air Sampling Detectors: Per test methods in the manufacturer's published instructions, detector alarm response shall be verified through the end sampling port on each pipe run. Verify airflow through all other ports as well.

13. Alarm Signaling Devices (Notification Appliances):

- a) Each alarm signaling device shall be tested and the decibel reading taken at ten feet from the device and recorded to ensure proper operation.
- b) For notification appliances installed in finished spaces, audibility testing shall be done after all interior walls, partitions, furniture systems, carpet and finishes have been installed. Only the base building may be tested in "shell" condition (prior to buildout), if necessary in order to obtain occupancy certificate from local authority having jurisdiction.
- c) Each alarm signaling device shall be functionally tested for proper wiring supervision.
- d) Decibel reading shall be taken to ensure that the alarm signal level can be clearly heard in all areas of the facility and that appropriate sound-pressure level is achieved.
- e) All visual alarm indicators shall be functionally tested to ensure proper operation and that they are clearly visible.

14. Alarm Verification: Testing procedures as given in NFPA 72.

15. Multiplex System: Testing procedures as given in NFPA 72.

16. Passive Smoke Control:

- a) Test operation of all fire alarm auxiliary relays associated with passive smoke control.
- b) Confirm that all air-movement fans and devices automatically shut down upon initiation of a fire alarm.

d. Record of Inspection:

1. Contents: A permanent record of all inspections, testing, and maintenance shall be provided, which includes the following information of periodic tests plus all the applicable information requested in NFPA 72 Figure 10.6.2.3.
 - a) Date
 - b) Test Frequency
 - c) Name of property
 - d) Address
 - e) Name of person performing work, affiliation, business address, and telephone number.
 - f) Approving agency name, address, and representative
 - g) Designation of detectors tested
 - h) Functional test of required sequence of operation
 - i) Check of all smoke detectors
 - j) Other tests as required by equipment manufacturer's published instructions
 - k) Signatures of tester and approved authority representative
 - l) Other items as noted in NFPA 72
2. Permanent Records: After successful completion of acceptance tests satisfactory to the authority having jurisdiction, a set of reproducible Record Drawings, Operation and Maintenance manuals, and a written sequence of operation shall be provided to the building owner or designated representative. In addition, inspection and testing reports shall be provided to the building owner or designated representative. It shall be the responsibility of the owner to maintain these records for the life of the system and to keep them available for examination by any authority having jurisdiction. Paper or electronic media shall be acceptable.
3. Software Archive: Provide non-rewritable CD and hardcopy printout of the entire site-specific software. Save a copy of site-specific software in non-volatile, non-erasable, non-rewritable memory (example: CD-R) and give five copies to Owner's representative for storage on site. Identify process of recording software changes. Include final Difference Report, Where-Used Report or other software change documentation run during system commissioning.

e. Smoke Control System Testing:

1. Special Inspection: Follow procedures and comply with International Building Code 909.3.
2. Acceptance Testing: Follow procedures and comply with International Building Code 909.18.
3. Detection Devices: Smoke or fire detectors that are part of a smoke-control system shall be tested in their installed condition. When applicable, this testing shall include verification of airflow in both minimum and maximum conditions.
4. Identification: Fire alarm system devices shall have an approved identifying tag or mark on them consistent with the other required documentation and shall be dated indicating the last time they were successfully tested and by whom.
5. Coordination: Coordinate testing of fire alarm system components involved in smoke control with Mechanical Division systems testing. Contractor shall arrange for all appropriate parties to be present for testing.
6. Before final inspection by the Building and Fire Department, a complete report of testing shall be prepared by an approved Special Inspector or Special Inspection Agency. Special inspections, testing, reports, identification and documentation shall comply with International Building Code 909.3

3.5 FIELD QUALITY CONTROL

c. Acceptance Testing: A final inspection and test of the system shall be rendered by the authorized factory representatives.

d. A Certificate of Compliance written by the authorized factory representatives, which states that the system is properly installed and does properly function as recommended by the factory and as described in this specification, shall be submitted to the Architect for approval.

e. A test run shall be performed by the authorized factory representative in the presence of the Owner, Architect, Engineer, and Authority Having Jurisdiction.

f. Coordination: It shall be the responsibility of the Contractor to coordinate all requirements surrounding installation of the fire alarm system will all trades including, but, not exclusive of: fire alarm system installing contractor, elevator contractor, electrical contractor, sprinkler contractor, and HVAC controls contractor. Adequate coordination shall be provided to ensure proper installation and interface to all peripheral items required to interact with the fire alarm and communication system.

END OF SECTION 28 31 00

APPENDIX A
ADVISORY CIRCULAR
150/5210-5D

BID DOCUMENTS
HANGAR DEVELOPMENTS
MARIANNA MUNICIPAL AIRPORT, MARIANNA, FLORIDA



U.S. Department
of Transportation

Federal Aviation
Administration

Advisory Circular

Subject: Painting, Marking, and Lighting of
Vehicles Used on an Airport

Date: April 1, 2010

AC No: AC 150/5210-5D

Initiated by: AAS-100

Change:

1. PURPOSE. This advisory circular (AC) provides guidance, specifications, and standards for painting, marking, and lighting of vehicles operating in the airport air operations area (AOA). The approved lights, colors, and markings herein assure the conspicuity of vehicles operating in the AOA from both the ground and the air.

2. CANCELLATION. This AC cancels AC 150/5210-5C, Painting, Marking, and Lighting of Vehicles Used on an Airport, dated August 31, 2007.

3. APPLICATION. The Federal Aviation Administration (FAA) recommends the guidelines and standards in this Advisory Circular for vehicles operating in the airport AOA. In general, use of this AC is not mandatory. *However*, use of this AC is mandatory for vehicles funded with federal grant monies through the Airport Improvement Program (AIP) and/or with revenue from the Passenger Facility Charges (PFC) Program. See Grant Assurance No. 34, "Policies, Standards, and Specifications," and PFC Assurance No. 9, "Standard and Specifications."

Vehicles covered by this AC that do not meet this standard may be used until the vehicle is repainted or replaced, but no later than **December 31, 2010**.

4. PRINCIPAL CHANGES. This AC contains new specifications and recommendations for the painting, marking, and lighting of Towbarless Tow Vehicles (TLTVs).

5. METRIC UNITS. To promote an orderly transition to metric units, this AC includes both English and metric dimensions. The metric conversions may not be exact equivalents, and until there is an official changeover to the metric system, the English dimensions will govern.

6. COMMENTS OR SUGGESTIONS for improvements to this AC should be sent to:

Manager, Airport Engineering Division
Federal Aviation Administration
ATTN: AAS-100
800 Independence Avenue, S.W.
Washington, DC 20591

Michael J. O'Donnell
Director of Airport Safety and Standards

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PAINTING, MARKING, AND LIGHTING OF VEHICLES USED ON AN AIRPORT

1. SOURCES OF APPLICABLE DOCUMENTS.

- a.** American National Standards Institute, Inc. (ANSI), 25 West 43rd St. 4th Floor, New York, NY 10036. Website: www.ansi.org
- b.** American Society for Testing & Materials (ASTM), ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959. Website: www.astm.org
- c.** The National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, Massachusetts 02169-7471. Website: www.nfpa.org
- d.** The U. S. General Services Administration (GSA), Centralized Mailing List Services, 501 West Felix Street, Whse 9, South End P.O. Box 6477, Fort Worth, Texas 76115-6477. Website: www.gsa.gov
- e.** The Superintendent of Documents, U.S. Government Printing Office, 732 North Capitol St. NW, Washington, DC 20401.
- f.** Society of Automotive Engineers, Inc. (SAE), 400 Commonwealth Drive, Warrendale, PA 15096-0001. Website: www.sae.org
- g.** FAA Advisory Circulars: U.S. Department of Transportation, Subsequent Distribution Office, Ardmore East Business Center, 3341 Q 75th Ave., Landover, MD 20785. Website: www.faa.gov
- h.** FAA Engineering Briefs: www.faa.gov/airports/engineering/engineering_briefs/

2. DEFINITIONS. The following definitions apply in this AC:

- a. Vehicle** – All conveyances, except aircraft, used on the ground to transport persons, cargo, equipment or those required to perform maintenance, construction, service, and security duties.
- b. Air Operations Area (AOA)** – The portion of airport that encompasses the landing, take off, taxiing, and parking areas for aircraft.
- c. Airport Emergency Vehicles** – Vehicles that are authorized in the AOA for emergency purposes (e.g., ambulances, aircraft rescue and fire fighting (ARFF) vehicles and emergency response vehicles) as authorized by the airport traffic control tower (ATCT) or an authorized on-site accident/incident commander.
- d. Airport Operations Vehicles** – Vehicles routinely used by airport operations personnel for airport inspection and duties associated with airfield operations (such as airfield condition reporting and Incident Command) on the AOA and Movement Area.
- e. Airport Security Vehicles** – Vehicles that are authorized in the AOA for security purposes, as needed (e.g. police cars).

- f. Airfield Service Vehicles** – Vehicles that are routinely used in the AOA for airfield service, maintenance, or construction (e.g. snow blowers, snowplows, maintenance trucks, and tractors).
- g. Aircraft Support Vehicles** – Vehicles that are routinely used in the AOA to support aircraft operations (e.g. aircraft pushback tractors, baggage/cargo tractors or trucks, air conditioning and aviation fuel trucks). These vehicles are typically owned by airlines, vendors, or contractors and are not eligible for Federal funding.
- h. Reduced Visibility** – Prevailing visibility is less than one statute mile (1609 meters) and/or the runway visual range (RVR) is less than 6,000 feet (1830 meters).
- i. Movement Area** – The runways, taxiways, and other areas of an airport/heliport that are used for taxiing/hover taxiing, air taxiing, takeoff, and landing of aircraft, exclusive of loading ramps and parking areas. At those airports/heliports with an operating airport traffic control tower (ATCT), specific approval for entry onto the movement area must be obtained from air traffic control (ATC).
- j. Other Vehicles** – Vehicles that are not routinely authorized in the AOA (e.g. construction vehicles). These vehicles are typically owned by airlines, vendors, or contractors and are not eligible for Federal funding.
- k. Peak Intensity** – Peak intensity, for purposes of this document, means the maximum magnitude of luminescence as measured in candela.
- l. Towbarless Tow Vehicle (TLTV)** – a type of aircraft support vehicle whose main purpose is to tow aircraft in the AOA by way of nose gear capture.

3. VEHICLE PAINTING.

NOTE: *Airport vehicle paint and markings are a safety of flight requirement. The approved colors/markings herein assure conspicuity of vehicles operating in the AOA from both the ground and air.*

a. Airport Emergency Vehicles.

(1) Ambulances. Ambulance vehicles are painted per the most current version of Federal Specification KKK-A-1822, *Federal Specification for the Star-of-Life Ambulance*. Ambulances are not considered vehicles routinely operating on the AOA.

(2) Aircraft Rescue and Fire Fighting (ARFF) Vehicles. Yellowish-green is the vehicle color standard. Color specifications are per Appendix A.

NOTE: *A yellowish-green color provides optimum visibility during all light levels encountered during a 24-hour day and under variations of light that result from weather and seasonal changes.*

b. Airport Operations Vehicles. Airport operations vehicles may be painted in colors designated by the airport operator. The characteristics must be coordinated with the respective ATCT and identified in the tower letter of agreement.

c. Airport Security Vehicles. Comply with specific state or local requirements.

d. Airfield Service Vehicles. Chrome yellow is the vehicle color standard. Color specifications are per Appendix A. When vehicles are equipped with bumper bars 8 inches (200 mm) or more in depth, the bars must be painted in alternate stripes 4 inches (100 mm) in width of chrome yellow and black inclined 45° to the vertical.

e. Aircraft Support Vehicles.

(1) Any color or combination of colors other than yellowish-green or chrome yellow. The bumper bar paint scheme in paragraph 3.d (of alternating chrome yellow and black stripe) is recommended.

(2) **TLTVs.** International orange is the vehicle color standard. Retroreflective tape covering more than 25 percent of the vehicle's vertical surfaces may be used as a temporary measure to meet this standard prior to scheduled vehicle painting.

f. Other Vehicles. Any color or combination of colors other than solid black or white.

4. VEHICLE MARKING.

a. Airport Emergency Vehicles.

(1) **Ambulances.** Ambulances are marked per the most current version of Federal Specification KKK-A-1822.

(2) **ARFF Vehicles.** Emergency rescue and fire fighting vehicles are marked with the letters "ARFF," "Fire," or "Rescue" and in accordance with 4.c.(1)-(5) of this AC.

b. Airport Operations Vehicles. Airport operations vehicles may be marked as designated by the airport operator. Marking must be coordinated with the respective ATCT and identified in the tower letter of agreement.

c. Airfield Service Vehicles and Aircraft Support Vehicles.

(1) Airport operator owned vehicles must display an identification number on each side and on the roof (the hood should be used if the vehicle has no roof).

(2) Side numbers will be a minimum of 16 inches (410 mm) in height and conspicuously located.

(3) Roof numbers will be a minimum of 24 inches (610 mm) in height and affixed with their bases toward the front of the vehicle. The identification numbers should provide sharp color contrast to the vehicle color.

(4) In addition to the identification numbers, airport operator-owned vehicles must display either the name of the airport and/or the airport insignia.

(5) To further improve night-time recognition of vehicles, a minimum 8 inch (200 mm) wide horizontal band of high gloss white paint or white reflective tape (Retroreflective, ASTM-D 4956-09, *Standard Specification for Retroreflective Sheeting for Traffic Control*, Type III & above) must be used around the vehicle's surface. Figures 1, 2, and 3 show suggested locations for the horizontal reflective band.

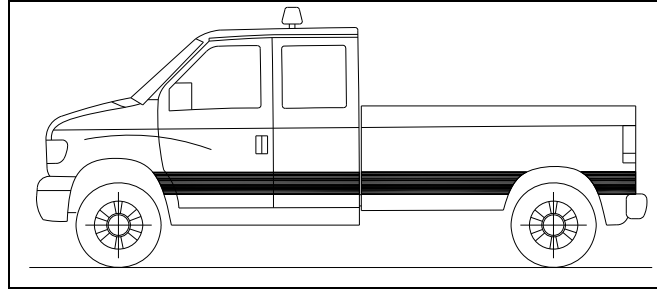


Figure 1: Suggested location for the horizontal reflective band, Option 1

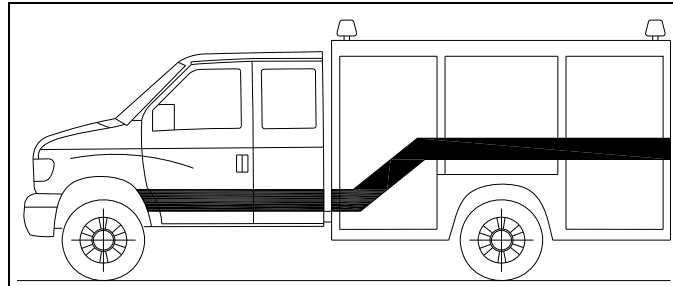


Figure 2: Suggested location for the horizontal reflective band, Option 2

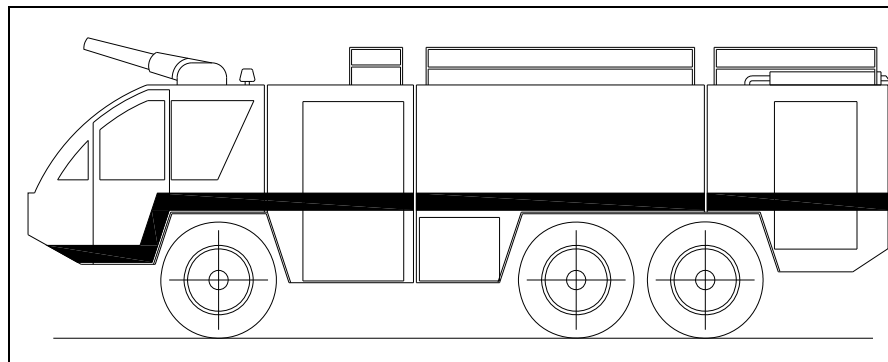


Figure 3: Suggested location for the horizontal reflective band, Option 3

(6) **TLTVs.** Retroreflective tape is used to outline the shape of a TLTV. If the vertical edge of the vehicle is rounded, the tape should be placed on the rounded portion to reflect light in both the horizontal and vertical planes. Where the placement of the tape may interfere with, or may be worn down by, maintenance or operational activities, tape is not required. Suggested locations for the retroreflective bands are shown in Figure 4.

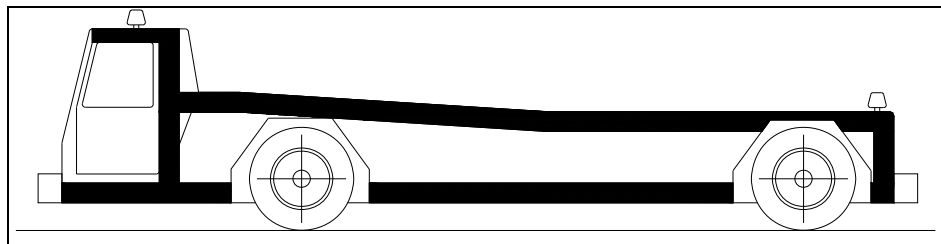


Figure 4: Suggested placement of retroreflective tape on a TLTV

d. Airport Security and Other Vehicles.

- (1) Vehicles other than those that routinely traverse any portion of the AOA under the control of ATC, which are not escorted by a vehicle in constant two-way radio communication with ATC and properly equipped and authorized to operate in the AOA, must be provided with a flag on a staff attached to the vehicle so that the flag will be readily visible.
- (2) At airports without air traffic control facilities, flags must be provided on all vehicles.
- (3) The flag must be at least a 3-foot by 3-foot (0.9 meter by 0.9 meter) square having a checkered pattern of international orange and white squares at least 1 foot (300 mm) on each side (see Appendix A for the fabric color specification).

5. VEHICLE LIGHTING.

a. Airfield Service, Aircraft Support, and Airport Operations Vehicles.

- (1) The standard for identification lighting is a yellow flashing light that is mounted on the uppermost part of the vehicle structure. A steady yellow light designates vehicles limited to non-movement areas.
- (2) The light must be visible from any direction, day and night, including from the air.
- (3) Color specifications for vehicle identification lights are per Appendix B.
- (4) **TLTVs.** An LED light bar placed above the operator's cab may be used in place of the rotating yellow flashing light. In addition, a yellow flashing light (of any type) must be installed on the upper left-rear and right-rear corners of the TLTV, and must be activated when an aircraft is in tow. The size of the rear flashing lights must be large enough to meet the requirements of Section 5.c, but not so large as to interfere with the normal or towing operations of the TLTV.

b. Airport Emergency, Security, and Other Vehicles, which are not escorted by a properly lighted vehicle, must be identified during periods of low visibility by a light.

c. Characteristics of Flashing Lights:

- (1) Ambulance lights must meet the specifications in the most current version of Federal Specification KKK-A-1822, and ARFF vehicles must meet NFPA, state, and local requirements.
- (2) Lights must have peak intensity within the range of 40 to 400 candelas (effective) from 0° (horizontal) up to 10° above the horizontal and for 360° horizontally. The upper limit of 400 candelas (effective) is necessary to avoid damage to night vision.
- (3) From 10° to 15° above the horizontal plane, the light output must be 1/10th of peak intensity or between 4 and 40 candelas (effective).

- (4) Lights must flash at 75 ± 15 flashes per minute.

NOTES:

1. *The effective intensity of a flashing light is equal to the intensity of a steady-burning (fixed) light of the same color that produces the same visual range under identical conditions of observation.*

2. *If xenon flashtubes are used, refer to AC 150/5345-43, Specification for Obstruction Lighting Equipment, for guidance concerning methods of calculating effective intensity.*

d. Light Colors.

(1) Airport Emergency Vehicles.

(a) **Ambulances.** Per the most current version of Federal Specification KKK-A-1822.

(b) **ARFF Vehicles.** Red or a combination of red-and-white flashing lights per the chromaticity requirements in Appendix B.

(2) Airport Security Vehicles. Signal blue or a combination of red and signal blue flashing light per the chromaticity requirements in Appendix B.

(3) Airfield Service, Aircraft Support, Airport Operations, and Other Vehicles. Yellow flashing light per the chromaticity requirements in Appendix B.

APPENDIX A. COLOR SPECIFICATIONS

A-1. SPECIFICATIONS. Colors specified in Table A-1 are per the Commission Internationale de l'Eclairage (CIE) L*a*b* system of color specification. For a description of this system, refer to American Society for Testing & Materials (ASTM) D 2244, *Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates*.

Table A-1. Specification for vehicle and flag colors

Standard Illuminant D65 Usage	Chrome Yellow			Yellowish-Green			International Orange		
	Vehicle Paint			Vehicle Paint			Vehicle Paint / Flag Fabric		
CIELAB DATA	L*	a*	b*	L*	a*	b*	L*	a*	b*
Centroid Color	72.8	24.4	77.6	78.3	-10.2	80.4	45.0	53.5	52.0
Point 1	72.8	31.8	82.9	78.3	-9.0	92.0	45.0	61.4	47.8
Point 2	72.8	25.5	66.7	78.3	-7.6	73.2	45.0	53.9	41.4
Point 3	72.8	18.0	69.3	78.3	-11.0	69.3	45.0	53.5	53.4
Point 4	72.8	22.4	86.0	78.3	-13.4	86.2	45.0	49.7	60.4
Light Limit	77.8			83.3			49.9		
Dark Limit	67.8			73.3			41.6		
Max ΔE	11.1			11.7			10.7		

A-2. COLOR TESTS. Acceptable colors are those that meet the gloss rating test and either a visual or an instrumental color test as follows:

NOTE: *Flag fabric colors must meet either the instrumental tests in Table A-1 or the visual method described in paragraph A-2b(1).*

a. Gloss Rating Test. This test is performed per ASTM D 523, *Standard Test Method for Specular Gloss*, on a paint sample of the color to be applied on the vehicle. An acceptable color sample is high gloss with a minimum gloss rating of 70 units, for 60° geometry.

b. Color Test Methods:

(1) Visual. Prepare a master specimen of the color (per Table A-1) and gloss (per paragraph A-2a). This specimen will be the master color and be used as the basis of comparison per ASTM D 5531-05, *Standard Guide for the Preparation, Maintenance, and Distribution of Physical Product Standards for Color and Geometric Appearance of Coatings*. To verify the paint color of a vehicle visually, vehicle paint samples must be

prepared and viewed per ASTM D 1729-96 (Reapproved 2009), *Standard Practice for Visual Appraisal of Colors and Color Differences of Diffusely-Illuminated Opaque Materials*.

(2) Instrumental. This test requires a test specimen sample and reference to Table A-1. All test specimen measurements should be conducted per ASTM E 1164-09a *Standard Practice for Obtaining Spectrometric Data for Object-Color Evaluation*. Test specimen tolerances must be per Table A-1 per the following:

(a) Plot the centroid color using the a* and b* CIELAB coordinate data from Table A-1 on graph paper or by entry of the coordinate data into a computer program. Plot and connect points 1 through 4 from the same table to form a quadrilateral; noting that the centroid color is within this figure. See Figure A-1 for plots of all three color specifications in Table A-1.

(b) Perform color sample measurements per ASTM E 1164-09a. If necessary, convert measurements to CIELAB L*, a*, and b* color space. See ASTM E 308-08, *Standard Practice for Computing the Colors of Objects by Using the CIE System*, for color space conversion formulae.

(c) An acceptable color is one that meets:

(i) the chromaticity requirements of the color samples a* and b* CIELAB coordinate data by falling within the quadrilateral;

(ii) the L* data lightness requirement by falling within the range defined by the light and dark data of Table A-1;

(iii) the total color difference (ΔE) by not exceeding the limits in Table A-1 when the CIELAB data are computed in the following formula:

$$\Delta E = (\Delta L^{*2} + \Delta a^{*2} + \Delta b^{*2})^{\frac{1}{2}}$$

where ΔL^* , Δa^* , and Δb^* values are the differences between those values for the centroid color in Table A-1 and those of the color sample measurements.

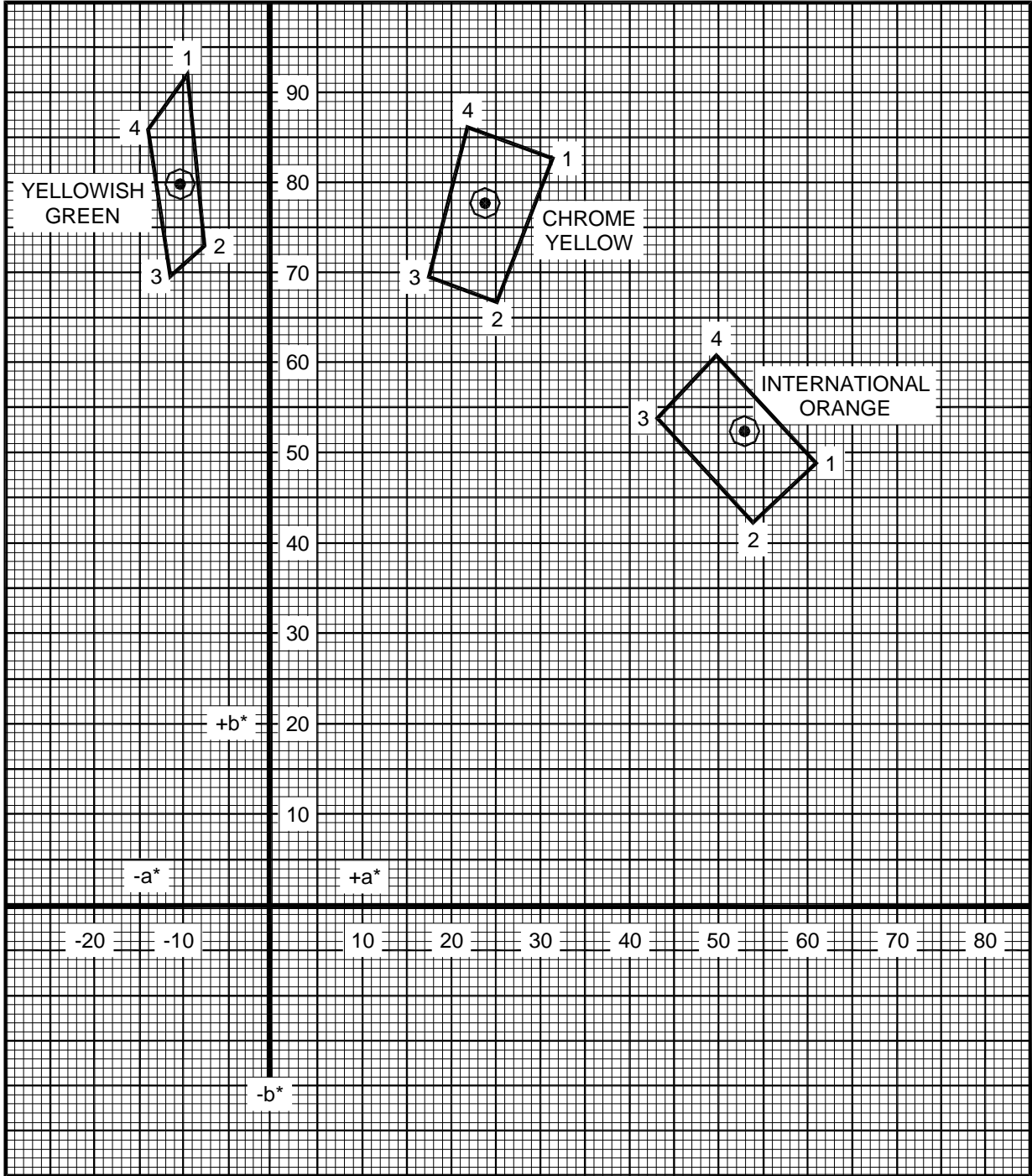


Figure A-1. Plot of selected color paint specifications

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APPENDIX B. COLOR SPECIFICATIONS FOR VEHICLE IDENTIFICATION LIGHTS

B-1. SPECIFICATIONS. The Society of Automotive Engineers (SAE) Standard J578 Revised December 2006, *Color Specification*, defines the acceptable color boundary limits and measurement of emitted red, white, signal blue, and yellow light for vehicle lights. This standard applies to the overall emitted color of light from the device in lieu of emitted light from any small area of the lens. The color of emitted light must fall within the color boundaries per SAE J578 Revised December 2006 (color boundary equations are in the standard) using color measurement methods detailed in the standard. See FAA Engineering Brief #67, *Light Sources Other Than Incandescent and Xenon for Airport and Obstruction Lighting Fixtures*, for additional information and *Alternative Lighting Devices*.

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**APPENDIX B
ADVISORY CIRCULAR
150/5200-18C**

**BID DOCUMENTS
HANGAR DEVELOPMENTS
MARIANNA MUNICIPAL AIRPORT, MARIANNA, FLORIDA**



U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

**Subject: AIRPORT SAFETY
SELF-INSPECTION**

Date: 04/23/04

AC No: 150/5200-18C

Initiated by: AAS-300 **Change:**

- 1. PURPOSE.** This Advisory Circular (AC) provides information to airport operators on airport self-inspection programs and identifies items that airport operators should include in such a program.
- 2. FOCUS.** Development of a self-inspection program in accordance with this AC represents an acceptable means of compliance with the 14 Code of Federal Regulations (CFR) Part 139 (Part 139) requirements.
- 3. CANCELLATION.** Advisory Circular 150/5200-18B, Airport Safety Self-Inspection, dated 5/2/88, is cancelled.
- 4. RELATED READING MATERIAL.**
 - a. 14 CFR Part 139, Certification of Airports.** While Part 139 requirements are mandatory for a holder of a Part 139 Airport Operating Certificate, the regulation contains many safety practices that the Federal Aviation Administration recommends for use at all airports.
 - b.** 14 CFR Part 77, Objects Affecting Navigable Airspace.
 - c.** Current editions of the following advisory circulars:
 - (1) AC 150/5200-33, Hazardous Wildlife Attractants on or near Airports
 - (2) AC 150/5210-21, Airport Certification Manual (ACM). This reference is pertinent for certificated airports only.
 - (3) AC 150/5210-20, Ground Vehicle Operations on Airports.
 - (4) AC 150/5200-28, Notices to Airmen (NOTAMs) for Airport Operators.
 - (5) AC 150/5200-30, Airport Winter Safety and Operations.
 - (6) AC 150/5210-5, Painting, Marking, and Lighting of Vehicles Used on an Airport.
 - (7) AC 150/5230-4, Aircraft Fuel Storage, Handling, and Dispensing on Airports.
 - (8) AC 150/5300-13, Airport Design.
 - (9) AC 150/5340-1, Standards for Airport Markings.
 - (10) AC 150/5340-18, Standards for Airport Sign Systems.
 - (11) AC 150/5340-21, Airport Miscellaneous Lighting Visual Aids.
 - (12) AC 150/5340-24, Runway and Taxiway Edge Lighting System.

- (13) AC 150/5340-26, Maintenance of Airport Visual Aid Facilities.
- (14) AC 150/5370-2, Operational Safety on Airports During Construction.
- (15) AC 150/5370-10, Standards for Specifying Construction of Airports.

d. Obtain the latest version of the free Advisory Circular publications from the FAA on its Web site at www.faa.gov/arp/. In addition, these ACs are available by contacting the U.S. Department of Transportation, Subsequent Distribution Office, SVC-121.23, Ardmore East Business Center, 3341 Q 75th Avenue, Landover, MD 20785. All FAA ACs are listed in the Advisory Circular Checklist, AC 00-2.1, which is available on the internet. The Checklist also explains how to obtain the circulars.

5. BACKGROUND.

a. While some hazardous airport conditions develop virtually instantaneously, others are gradual. It is important that the airport operator have an airport safety self-inspection program that monitors specific airport conditions in order to identify unsatisfactory conditions for prompt corrective actions. A number of airport operators have some form of a safety self-inspection program. The programs vary in scope and effectiveness from verbal instructions and unscheduled and unrecorded inspections to very comprehensive inspection programs with multiple daily schedules and widely distributed responsibilities.

b. At airports certificated under 14 CFR Part 139, the self-inspection program is a key component of an airport operator's airport certification program and required under §139.327. An effective self-inspection program enables an airport operator to operate in compliance to Part 139 standards on a day-to-day basis. In accordance with Part 139, all airports must have an Airport Operating Certificate if serving—

(1) Scheduled or unscheduled passenger operations of an air carrier with aircraft having a seating capacity of more than 30 passengers, or

(2) Scheduled passenger operations with aircraft having a seating capacity of more than 9 and less than 31 passengers.¹

One of the requirements of Part 139 is that the operator of each certificated airport regularly conduct a daily safety self-inspection to ensure that prompt corrective action is taken to eliminate unsafe conditions on the airport. The specific requirements of the self-inspection program at each certificated airport are addressed in the airport certification manual.

c. This AC suggests components, responsibilities, and items for regularly scheduled, continuous surveillance, periodic condition and special inspections, and checklists for use during any of these airport safety self-inspections. This guidance can be modified as necessary to meet local situations. The information and guidance in this publication serve as a basis by which airports operators may develop their own safety self-inspection programs.

6. RESPONSIBILITIES.

a. **Safety Self-Inspection.** Self-inspection is a primary responsibility of the airport owner, operator, or a duly authorized representative. It is customary to assign the job of assuring overall airport ground safety to the airport manager or operations supervisor. Primary attention should be given to such operational items as pavement areas, safety areas, markings, signs, lighting, aircraft rescue and fire fighting, fueling operations, navigational aids, ground vehicles, obstructions, public protection, wildlife

¹ Part 139 is only applicable in the State of Alaska to airport operators serving scheduled or unscheduled passenger operations of an air carrier with aircraft having a seating capacity of more than 30 passengers.

hazard management, construction, and snow and ice control. Inspection of areas that have been assigned to individual air carriers, fixed base operators, or other tenants can be made the responsibility of the user. However, at Part 139 airports, the FAA will hold the certificate holder ultimately responsible for operating the airport safely.

b. Recommended Inspection Frequency.

(1) **Regularly scheduled inspection.** The airport should be inspected at least daily during times when aircraft activity is minimal in order to create the least impact on airport operations. Part of this inspection should be done during the hours of darkness at those airports that serve air carriers after dark.

(2) **Continuous surveillance inspection.** Those activities and facilities that have been identified to require continuous surveillance should be inspected any time personnel are in the air operations area. Hazardous conditions can occur at any time and in a short period of time.

(3) **Periodic condition inspection.** Periodic condition inspection of activities and facilities can be conducted on a regularly scheduled basis but less frequently than daily. The time interval could be weekly, monthly, or quarterly, depending on the activity or facility.

(4) **Special inspection.** Special inspections of activities and facilities should be conducted after receipt of a complaint or when an unusual condition or unusual event occurs on the airport, such as a significant meteorological event or an accident or incident. Special inspections should also be conducted at the end of construction activity to ensure that there are no unsafe conditions present related to the construction activity. A special inspection should be conducted prior to construction personnel leaving the airport in the event that corrective actions are necessary. Special inspections should be documented on the appropriate portions of the regularly scheduled inspection checklist.

c. Inspection Records. An effective safety self-inspection program includes procedures for reporting and correcting deficiencies. This means that the airport operator should have a work order system in place so that deficiencies can be corrected in an expeditious manner.

(1) The operator should issue a Notice to Airmen (NOTAM), as appropriate, through the appropriate Flight Service Station (FSS) reporting deficient conditions that could have an immediate and critical impact on the safety of aircraft operations. When corrective actions have been taken, the NOTAM should be cancelled. At Part 139 airports, other similar systems and procedures may be used if approved by the FAA.

(2) For even the smallest airport, it is desirable to use a safety self-inspection checklist that constitutes a written record of conditions noted, and acts as a check on follow-up actions taken. The scheduled use of a dated checklist will assure the regularity and thoroughness of safety inspections and follow-up. The checklist can be an important administrative tool for airport management. It can provide a snapshot of the condition of the airport, indicating trends, defining problem areas, indicating systems that are beginning to deteriorate and helping to define budgetary requirements. It is most desirable to use a format (see examples, Appendices 1–5) in which each inspected area of the airport complex is positively noted. Retain the checklist until indicated actions are completed. Airports certificated under Part 139 must retain the regularly scheduled inspection checklist for 12 months. Airports may use additional, specialized materials and forms, such as maintenance work orders, NOTAMs, fire station and first aid reports, etc. Some airport operators use computerized versions specifically designed to meet their self-inspection requirements. There are several vendors that have developed these computer programs that can use laptops and Personal Data Assistants (PDAs). However, the regularly scheduled inspection checklist should be the basic log documenting that safety inspection responsibilities are being met.

d. Follow-up. The airport operator should follow up on complaints or requests for corrective action and on all deficient items or problem areas noted during the daily inspection. Determine which problems

require immediate attention and treat those with highest priority, including developing appropriate NOTAM notification.

7. INSPECTION TECHNIQUES.

Inspectors should vary the pattern of the inspection. Fixed inspection patterns, while easy to learn, do not provide for an adequate inspection. The use of such fixed inspection patterns can lead to complacency and to the possibility of missing items that are in need of correction. When conducting an inspection on a runway and when there is time to do only one pass on that runway, inspection personnel, whenever practical, should drive towards the direction of landing aircraft with high intensity flashing beacon and headlights on day and night. This practice will enable self-inspection personnel to see approaching aircraft and improve visibility of the vehicle to pilots. However, it is recommended that a runway inspection be done in both directions. Inspection personnel should also drive the stub taxiways between the runway and parallel taxiway as these areas are commonly overlooked.

8. KNOWLEDGE AND EQUIPMENT FOR SELF-INSPECTION.

a. Airport personnel who conduct safety self-inspections (referred to as inspectors in this AC) should receive training in at least the following areas:

b. Inspectors should know the location and types of airport facilities, airport rules and regulations and, at Part 139 airports, be familiar with the FAA-approved Airport Certification Manual.

- (1) Airport familiarization, including airport signs, marking, and lighting;
- (2) Airport Emergency Plan (if the airport has one);
- (3) Notice to Airmen (NOTAM) notification procedures;
- (4) Procedures for pedestrians and ground vehicles in movement areas and safety areas;
- (5) Airport inspection procedures and techniques; and
- (6) Discrepancy reporting procedures.

c. Inspectors should know the FAA Advisory Circular standards applicable to the airport and have access to copies for reference. Some applicable standards can be found in the FAA Advisory Circulars listed in paragraph 3c. (This is not an all-inclusive list.). They can also be found on the Internet at www.faa.gov.

d. Inspectors should have a vehicle equipped with:

(1) a two-way ground control radio capable of communicating with the Airport Traffic Control Tower on controlled airports and on the Common Traffic Advisory Frequency (CTAF) or UNICOM at uncontrolled airports (or at controlled airports when the tower is closed);

(2) a beacon for nighttime (or inclement weather conditions) inspections; and

(3) either a beacon or checkered flag for daytime inspections.

e. Inspectors should know and use correct radio communication phraseology, procedures and techniques, as specified in the Aeronautical Information Manual. If the airport operator uses airport police to do all or part of the self-inspection, the police should use aviation terminology and not 10-4 codes.

f. Inspectors should be supplied with checklists covering the various inspection areas (sample airport safety self-inspection checklists are contained in Appendices 1–5). While format of checklists vary, it is important to develop a checklist that is useful for the airport and its operation. If certain

inspectors will be responsible for only certain items, separate checklists pertinent to those areas may be developed. A sketch of the airport should accompany the checklist so that the location of problems can be marked for easy identification.

g. Inspectors should review the most recently completed checklist from the previous inspection cycle prior to beginning the inspection.

h. If construction is in progress, inspectors should be familiar with the safety plan for the project.

i. If the airport is certificated under Part 139, inspectors should be familiar with the airport certification manual requirements concerning training and self-inspection.

9. COMPONENTS OF A SAFETY SELF-INSPECTION PROGRAM. A successful safety self-inspection program has four components:

a. A regularly scheduled inspection of physical facilities (which must be conducted daily at airports certificated under Part 139 or in accordance with the FAA-approved airport certification manual). If the airport serves air carriers after dark, there should also be a nighttime inspection of lighting;

b. Continuous surveillance inspection of certain airport activities, such as fueling operations, construction, airfield maintenance;

c. A periodic condition inspection program for such things as surveying approach slopes, obstructions, etc.; and

d. Special condition inspections during unusual conditions or situations, such as changing weather or days of unusually high number of aircraft operations.

10. REGULARLY SCHEDULED INSPECTION.

The regularly scheduled inspection consists of specific observations of airport physical facilities on at least a daily basis. This inspection should concentrate on the areas described in this section, which are also included in Appendix 1. If deficiencies exist, the inspector should indicate the deficient item and identify its location on a airport sketch, providing dimensions and depths, as necessary. If appropriate, the inspector should take photographs to document the condition.

a. Pavement Areas. The condition of pavement surfaces is an important part of airport safety. Pavement inspection should be conducted daily before flight operations commence to ensure pavement surfaces are clear. As a minimum, a daily inspection should be performed of all paved areas that are the responsibility of the airport operator or as specified in the FAA-approved Airport Certification Manual. During the pavement inspection, the inspector should:

(1) Check the pavement lips—the area between full-strength pavement and shoulders or paved shoulders and safety areas—to assure that they are no greater than necessary to allow water to drain off the pavement. A lip height no greater than 1 1/2 inches is usually sufficient to allow proper drainage. (At airports certificated under Part 139, pavement lips shall not exceed 3 inches as stated in § 139.305.)

(2) Determine if there are any cracks wide enough to cause directional control problems for an aircraft. Report and monitor these cracks.

(3) Determine if there are any holes that could cause directional control problems for an aircraft. (At airports subject to Part 139, any hole that cannot be covered by a 5-inch circle, and the side slope at any point in the hole that exceeds 3 inches in depth and is 45 degrees or greater, is a discrepancy. If the hole cannot be covered by a 5-inch circle but the side slope at any point in the hole that exceeds 3

inches in depth or is less than 45 degrees, it may be a discrepancy if it is determined to be a surface variation that could impair directional control of an air carrier aircraft.)

(4) Check the condition of pavement areas for cracks, scaling, spalling, bumps, low spots, and for debris that could cause foreign object damage to aircraft.

(5) Check for vegetation growth along runway and taxiway edges that may impede drainage from the pavement surface.

(6) Check for vegetation growth in cracks.

(7) Report and monitor any cracks, holes, variations and vegetation that can cause loss of aircraft directional control or may cause pavement damage, including damaged caused by damming or ponding water.

b. Safety Areas. The inspector should know the dimensions of the runway and taxiway safety areas at the airport. At airports certificated under Part 139, the dimensions of the safety areas should be documented in the airport certification manual. During the safety area inspection, the inspector should:

(1) Determine if there are any hazardous ruts, depressions, humps or variations from the normal smooth surface.

(2) Check to ensure no object is located in a safety area, except objects that must be in the safety areas because of their functions (such as runway lights, signs, or navigational aids). These objects must be constructed on frangibly mounted structures of the lowest practical height. At Part 139 airports, the frangible point must be no higher than 3 inches above grade.

(3) Determine if the base for any equipment in safety areas is at grade level (especially during the winter thaw) and equipment and NAVAIDs mounted on frangible couplings.

(4) Check to ensure that manhole and handhole covers are at grade level and can support vehicles and aircraft. Check to ensure that mounts for light fixtures are at grade level.

(5) Check for surface variation and other damage caused by rodents or other animals.

(6) Report any objects that are not frangible or not at grade level. Also report extraneous equipment and objects, such construction equipment, and surface variations that would cause damage to an aircraft or impede emergency response vehicles. At airports certificated under Part 139, issue a NOTAM regarding objects in the safety area contrary to § 139.309 (see § 139.339)

c. Markings. Airport markings provide important information to pilots during takeoff, landing, and taxiing. To avoid confusion and disorientation, airport markings should be in compliance with FAA marking standards specified in AC 150/5340-1, Standards for Airport Markings. (Compliance with these standards is mandatory for operators of airports certificated under Part 139 and for airport operators that have accepted Federal funds for runway and taxiway construction/rehabilitation.) The inspector should know the appropriate markings required at the airport. During the marking inspection, the inspector should:

(1) Check markings for correct color-coding, peeling, blistering, chipping, fading, and obscurity due to rubber buildup.

(2) Check to see if all runway hold position markings are clearly visible.

(3) During and after construction projects, check new markings for compliance with FAA marking standards.

(4) If the markings have glass beads, check markings during periods of darkness to determine if the reflectivity of glass beads is adequate at night.

(5) Report and monitor any nonstandard marking or markings that are obscured, faded or deteriorating.

d. Signs. Signs provide important information to pilots while taxiing. To avoid pilot confusion and disorientation, airport signs should be in accordance with FAA sign standards specified in AC 150/5340-18, Standards for Airport Sign Systems. (Compliance with these standards is mandatory for operators of airports certificated under Part 139 and for airport operators that have accepted Federal funds for runway and taxiway construction/rehabilitation.) The inspector should know the appropriate sign standards and specifications at the airport and at a Part 139 certificated airport, ensure signs comply with the FAA-approved Sign Plan.

(1) Check signs to ensure they are easy to read, in accordance with color standards, retro-reflective, and that all lighted signs are working and not obscured by vegetation, dirt, snow, etc.

(2) Check signs to ensure they are frangibly mounted and concrete bases are properly maintained at grade level.

(3) Check to see that sign panels are not missing or damaged, that they have the correct legend and arrow orientation, and that they are not cracked or broken.

(4) During and after construction projects, check new signs for compliance to FAA sign standards and, at Part 139 airports, in accordance with the FAA-approved Sign Plan.

(5) During periods of darkness, check signs to ensure they are properly illuminated. Ensure mandatory instruction signs are illuminated with the associated runway lighting system. Check signs for correct operations; that they are on the correct circuits, they do not flicker and that they follow the intensity setting of the runway or taxiway lights.

(6) Report and monitor any nonstandard sign or any sign that is not functioning, is faded or damaged. At airports certificated under Part 139, issue a NOTAM regarding any malfunctioning holding position sign or ILS critical are sign, as specified under § 139.339

e. Lighting. At night and during periods of low visibility, lighting is important for safe airport operations. Lights come in different shapes, sizes, colors, and configurations and can be located either in the pavement or along its edges. Inspection of lighting is best accomplished during periods of darkness in order to evaluate lighting systems when they provide the primary visual aid for pilots. The inspection should concentrate on the lighting owned by the airport operator. However, the inspector should observe any lighting owned or operated by others and report any observed problems immediately to the appropriate responsible owner. During the lighting inspection, the inspector should:

(1) Check to ensure that the following are operable, if installed, and that vegetation or deposits of foreign material do not obscure the light fixture.

(i) Runway and taxiway edge lights;

(ii) Apron edge lights;

(iii) Runway centerline and touchdown zone lights;

(iv) Taxiway centerline lights or centerline reflectors;

(v) Runway threshold/end lights; and

(vi) Runway guard lights (both elevated and in-pavement, if installed).

(2) Check that the following are operable, if installed:

(i) Ramp lights and floodlights used in construction to ensure they are properly shielded);

- (ii) Obstruction lights; and
- (iii) Lighting in fuel storage areas.
- (3) Report all fixtures missing and lights that are not working or appear dim.
- (4) Report any missing or broken light fixture lenses.
- (5) Ensure that runway and taxiway lights and runway threshold lights are the proper color and are oriented correctly.
- (6) Check that lights function properly through the manual or radio control features, and that photocell controls function properly.
- (7) Check the lights for proper alignment, aiming and correct changes in intensity, for correct height, erosion around the bases and the height of frangibility.

f. Navigational Aids (NAVAIDs). The inspection of NAVAIDs should concentrate on the visual navigational aids owned by the airport operator. However, the inspector should observe any navigational aids owned or operated by others, such as the FAA, and report any observed problems immediately to the NAVAID owner. During the inspection of NAVAIDs, the inspector should:

- (1) Determine if the segmented circle is clear of vegetation and that it can be seen easily from the air.
- (2) Determine if the airport rotating beacon is visible and working properly.
- (3) Check the wind cone(s) to ensure that it swings freely, the cone fabric is not faded or frayed, and, if lighted, that all lights are operating.
- (4) Determine if the Runway End Lights (RENs, formerly known as Runway End Identifier Lights) are flashing in proper sequence and mounted on frangible couplings.
- (5) Check Visual Glide Slope Indicators (VASIs, PLASIs, or PAPIs) to ensure that their lights are working and mounted on frangible couplings.
- (6) Determine if the Approach Lighting systems are functioning properly.
- (7) Report and monitor any NAVAID that is malfunctioning, inoperable or misaligned, damaged or missing.

g. Obstructions. The inspection of obstructions should concentrate on a visual check of construction underway on or near the airport that could affect aircraft operations. This also includes checking for any vegetation, especially, trees, that may penetrate the Part 77 surfaces. During the inspection of obstructions, the inspector should:

- (1) Check to ensure that construction equipment, especially tall cranes being used at construction sites, are not an obstruction. If construction is found and thought to create an obstruction, the airport operator should determine if proper notification to FAA, such as is required through Part 77 or Airport Layout Plan review, has been provided.
- (2) Determine if obstructions are properly marked and lighted.
- (3) Direct any person proposing construction near a public-use airport meeting the notice requirements contained in Part 77, Objects Affecting Navigable Airspace, to the Air Traffic Division or Airports District Office immediately if their construction has not been reported to the FAA.
- (4) Report and monitor any obstruction light that is missing, inoperative or damaged, and any object that appears to be an obstruction and is not properly marked or lit.

h. Fueling Operations. The daily inspection on aircraft fueling operations should concentrate on a quick inspection for the most common problems concerning compliance with local fire safety codes at fuel storage areas and with mobile fuelers. The inspection should also include security, fire protection, general housekeeping, and fuel dispensing facilities and procedures. A more detailed fueling operation inspection should be scheduled quarterly (see Quarterly Fueling Operations under Periodic Condition Inspection). During the daily inspection of aircraft fueling operations, the inspector should:

- (1) Determine if the fueling operator is permitting any unsafe fueling practices or is in violation of local fire code, such as failure to bond aircraft with the mobile fuelers during fueling operations or fueling personnel smoking while fueling aircraft.
- (2) Check to ensure that the appropriate signs for the fuel farm are installed and that all gates are locked except when the facility is occupied by an authorized user.
- (3) Report and monitor any unsafe fueling practices and violation of local fire codes. At Part 139 airports, report any noncompliance with fuel fire safety procedures specified in the FAA-approved Airport Certification Manual.

i. Snow and Ice. The inspector should be familiar with the airport's snow and ice removal procedures and guidance provided in AC 150/5200-30, Airport Winter Safety and Operations. At Part 139 certificated airports, the inspector should be familiar with the airport's FAA-approved Snow and Ice Control Plan. During the snow and ice control inspection, the inspector should:

- (1) Determine if any lights and signs are obscured by snow or damaged by snow removal operations.
- (2) Check to ensure that snow banks and drifts next to the runway and taxiways provide clearance for aircraft wing tips, engines, and propellers.
- (3) Check to ensure that snow is not piled across the runway threshold or across runway/runway intersections.
- (4) Check to be sure that no foreign objects are left on the pavement from snow removal operations.
- (5) Check to ensure that snow removal operations have not blocked any taxiways or access routes dedicated for aircraft rescue and fire fighting equipment.
- (6) Check to ensure that snow is not accumulated or piled in the critical areas for electronic NAVAIDs.
- (7) Check for and report slippery pavement conditions in terms of either braking action or MU values. If a friction measurement device is available, issue the appropriate numbers obtained from the equipment. (Do not attempt to correlate friction measurement numbers with braking action reports.)
- (8) Report and monitor any snow and ice accumulation that has been missed by the snow and ice removal operation, and any dangerous condition created by such operations, such as obscured signs or lights. At airports certificated under Part 139, issue a NOTAM regarding snow, ice, slush or water on the movement area or loading ramps, and parking areas, as specified under § 139.339.

j. Construction. The inspector should be familiar with the airport's construction safety procedures and guidance provided in AC 150/5370-2, Operational Safety on Airports During Construction. At Part 139 certificated airports, the inspector should be familiar with the airport's FAA-approved Construction Safety Plan. During the construction inspection, the inspector should:

- (1) Determine if stockpiled material and construction materials are properly stored to keep them from being moved by wind, jet blast, or prop wash, and is not left in safety areas or movement area.

- (2) Check all construction adjacent to movement areas to ensure areas are identified with conspicuous marking and lighting.
- (3) Determine if construction equipment (such as bulldozers, cranes, etc.) are marked and lighted and parked clear of the safety areas.
- (4) Ensure construction barricades are properly positioned to define the limits of construction and hazardous areas and, if barricades are lighted, check to ensure lights are working properly and are positioned correctly.
- (5) Check to ensure that debris and foreign objects are continuously being picked up around construction areas.
- (6) Check for open trenches in the safety areas or adjacent to movement areas.
- (7) Check operation of lighting in areas adjacent to construction daily before the construction crews depart for the day. In particular, ensure that mandatory instruction signs remain lit with the associated runway lights, even on taxiways that have been closed for construction.
- (8) Check NOTAMs daily during construction projects to ensure they accurately reflect the conditions on the airport.
- (9) Verify that closed taxiways or runways are properly marked and lighted.
- (10) Report and monitor any dangerous condition created by construction activity, including damage to signs, lights, markings and NAVAIDS or equipment and supplies left in movement areas and safety areas.

k. Aircraft Rescue and Fire Fighting. During the inspection of aircraft rescue and fire fighting (ARFF) capabilities, the inspector should:

- (1) Check the status of ARFF response, including the availability of equipment, fire fighters and extinguishing agent. At Part 139 airports, ensure that such ARFF capabilities comply with the FAA-approved Airport Certification Manual and that the airport's ARFF Index is still appropriate for air carrier aircraft served.
- (2) Ensure alarm and emergency notification communication systems are operable.
- (3) Determine the adequacy of available fire extinguishing agents.
- (4) Check for construction or maintenance activity on the movement area that could affect ARFF response routes. Ensure that the ARFF Department has been notified if construction or maintenance activity could affect emergency response routes.
- (5) Report and monitor any ARFF vehicle, equipment or extinguishing agent that is not available or inoperative; any ARFF personnel that are not available; and any changes to aircraft that may require a change to ARFF capabilities. At Part 139 airports, notify the FAA if ARFF vehicles is inoperative and cannot be replaced immediately, as specified under § 139.319(g) and issue a NOTAM regarding non-availability of any rescue and firefighting capability, as specified under § 139.339.

l. Public Protection. During the public protection inspection, check gates, fencing, locks, and other safeguards are in place and functioning properly to prevent inadvertent entry to movement areas by unauthorized persons and vehicles and offer protection from jet blast. Report and monitor any safeguards that are damaged or missing. In accordance with the airport's security plan, report unauthorized persons or vehicles in the movement area (airports regulated by the Transportation Security Administration may have additional requirements for reporting and responding to unauthorized persons and vehicles).

m. Wildlife Hazard Management. During the wildlife hazard inspection, the inspector should check for evidence of birds or animals on the runways, taxiways, aprons, and ramps or other signs that

wildlife problems may have developed - such as large flocks of birds on or adjacent to the airport. Wildlife hazards found during the daily self-inspection should be properly documented. All dead wildlife found and all wildlife aircraft strikes should be reported to the FAA on the FAA Form 5200-7, Bird/Other Wildlife Strike Report. This form may be obtained from the FAA Internet site, at www.faa.gov. Additionally, the inspector should check fencing and gates for wildlife accessibility and should ensure that wildlife control equipment is available and operational.

11. CONTINUOUS SURVEILLANCE INSPECTION. Continuous surveillance inspection consists of general observation of activities for compliance with regulations, procedures, etc., as well as abnormalities with physical facilities that are readily apparent. This is performed any time inspection personnel are on the air operations area. Continuous surveillance of airport physical facilities and activities should cover at least the areas described in this section, which are also included in Appendix 2.

a. Ground Vehicles. During the continuous surveillance inspection of ground vehicles, the inspector should:

(1) Determine if vehicle drivers are following the airport's procedures and arrangements for the orderly operations of ground vehicles (including mowing machines or other maintenance vehicles in the safety areas). Extra attention should be paid to ground vehicle activity during construction, winter operations, and other special events.

(2) Report and monitor any vehicle operator that is not complying with the airport's vehicle procedures and arrangements.

(3) Report any ground vehicle accident observed and any ground vehicle signs and markings that are damaged, missing or obscured.

b. Fueling Operations. The inspector should:

(1) Emphasize fire and explosion hazards inherent in aircraft refueling.

(2) Ensure proper bonding is being used, deadman controls are not blocked, and no smoking prohibitions are being observed, and aircraft are not being fueled inside hangars.

(3) Check for proper parking of mobile fuelers to ensure these vehicles are at least 10' apart and 50' from buildings.

(4) Check for fuel leaks or spills in the fuel storage area and around mobile fuelers.

(5) Determine if the fuel farm is free of flammable materials, including litter and vegetation.

(6) Report and monitor any of unsafe fueling conditions discussed above and other obvious violations of local fire code and airport fuel fire safety procedures.

c. Snow and Ice. During the continuous surveillance inspection of snow and ice removal operations, the inspector should check snow or ice covered pavements and report and monitor any surfaces where snow and ice may affect the safety of aircraft operations. In addition, the inspector should monitor snow and ice removal NOTAMS to ensure they remain current and issue timely corrections, as necessary. If the airport uses other means to notify tenants of snow and ice removal operations, e.g., faxed or electronic messages, the inspector should also monitor this information for accuracy. Check to ensure that snow or ice on pavement surfaces does not affect the safety of aircraft operations and that NOTAMS are current.

d. Construction. The Inspector should check construction projects to ensure that the contractor is following the construction safety plan. During the continuous surveillance inspection of construction activity, the inspector should check for, and report, any of the following conditions:

- (1) Unauthorized use of runways, taxiways, and aprons by construction personnel and equipment.
- (2) Conditions that may result in runway incursions and other irregularities. This includes ensuring that construction areas are delineated appropriately with barricades, cones, markings, etc.
- (3) Construction equipment is not operated in ILS/MLS critical areas unless coordination with FAA has been accomplished.
- (4) Perimeter gates are left open and unattended, unlocked or construction vehicles and personnel are not following access and escort procedures.
- (5) Construction vehicles not properly marked or missing appropriate flags and/or beacons.
- (6) Foreign object debris on haul roads adjacent to movement areas that can be tracked onto taxiways, aprons, and ramp areas.
- (7) Confusing or missing signs, markings or lighting that could potentially confuse or mislead pilots.
- (8) Barricades and lighting are in place and operational.

e. Public Protection. Pay special attention to public protection during construction and special events. During the continuous surveillance inspection of safeguards used to protect the public, the inspector should check for, and report, any of the following conditions:

- (1) Unauthorized personnel, vehicles, and animals, particularly in areas aircraft passengers and the general public are present on the air carrier ramp and other portions of the movement area, i.e, remote aircraft parking locations.
- (2) Inoperable or blocked gates, particularly those that would impede access by aircraft rescue and fire fighting equipment.
- (3) Open or unlocked gates and missing or damaged signs posted to prevent unauthorized access to the airfield.
- (4) Damaged or missing jet blast fences.

f. Wildlife Hazard Management. During the continuous surveillance inspection of wildlife hazards, the inspector should check for, and report, any of the following conditions:

- (1) Birds or animals, such as dogs, deer, etc., on or adjacent to the runways, taxiways, aprons, and ramps to determine if there is a potential wildlife hazard problem.
- (2) Potential hazard created by birds on or adjacent to the airport.
- (3) Wildlife strikes and carcasses found on the runways. Report these on FAA Form 5200-7, Bird/Other Wildlife Strike Report. This form may be obtained from the FAA Internet site at www.faa.gov.

g. Foreign Object Debris (FOD). The inspector should continuously check for, and remove any FOD in movement areas, aircraft parking areas and loading ramps.

12. PERIODIC CONDITION INSPECTION. Periodic condition inspections consist of specific checks of physical facilities on a regularly scheduled basis (but less frequently than daily). Checks may require use of equipment (e.g., Walker Bar to measure VASI glide slope angles or transit to survey approach slopes, or continuous friction measurement equipment) or checking specific features of physical facilities. Periodic inspection of airport physical facilities and activities should cover at least the areas described in this section, which are also included in Appendix 3.

a. Pavement Areas. The inspector should check pavement surfaces for rubber buildup, polishing, or other items affecting friction.

b. Markings. The inspector should:

(1) Check pavement markings to ensure they are correct and clearly visible. Markings on concrete and faded asphalt should be outlined with a black border.

(2) Determine if markings are visible at night, especially examine for rubber buildup in the touchdown zone areas.

c. Signs. The inspector should check signs faces for peeling and for fading or faded colors.

d. Quarterly Fueling Inspections. Airports certificated under Part 139 are required to establish fire safety standards for safe fueling operations and conduct quarterly inspections of the fueling facilities. The inspection procedures in this section are based on the NFPA 407 fire code for airport fueling operations, which is one of the more common fire codes in effect at certificated airports. The fire safety standards for fueling operations should be listed in the Airport Certification Manual (ACM) and the quarterly inspections should be conducted for compliance to the fueling fire safety standards listed in the ACM. Sample quarterly inspection checklists for fuel storage areas and mobile fuelers are included in Appendix 5. Typical fire safety standards to inspect quarterly are listed below. Airports certificated under Part 139 are required to maintain a record of this inspection for at least 12 months.

(1) **Fuel storage areas and loading/unloading stations.** The inspector should:

(i) Check fuel storage areas for adequate fencing and security to prevent unauthorized access or tampering.

(ii) Check for “No Smoking” signs that are clearly visible.

(iii) Check fuel storage areas for materials such as trash or vegetation that could contribute to the spread of fire. Also check for equipment, functions or activities that could be ignition sources.

(iv) Note if fueling equipment appears to be in good operating condition and free of fuel leaks.

(v) Check piping for reasonable protection from damage by vehicles if piping is above ground.

(vi) Check fuel storage areas for at least two accessible and serviceable fire extinguishers. Where the open hose discharge capacity of the equipment is more than 200 gallons per minute, at least one wheeled extinguisher with at least 125 lbs of agent is also required.

(vii) Check for explosion proof equipment, switches and wiring that is reasonably protected from heat, abrasion or impact, which could cause an ignition source.

(viii) Check for piping, filters, tanks and pumps being electrically bonded together and interconnected to an adequate grounding rod.

(ix) Check for a serviceable bond/ground wire with clip at each loading/unloading facility for grounding tankers and mobile fuelers.

(x) Check loading stations for deadman control features.

(xi) Look for a boldly marked emergency cutoff capable of stopping all fuel flow with one physical movement. The emergency cutoff should be located outside the probable fuel spill area near the route that normally is used to leave the spill area or to reach the fire extinguishers.

(2) **Mobile fuelers.** At least once every 3 months, inspect all fuel trucks to ensure they meet fire safety standards. The inspector should:

(i) Note if mobile fuelers appear to be in good operating condition and free of fuel leaks.

(ii) Check mobile fuelers for parking at least 50 feet from a building and at least 10 feet from each other. Note: Some airports have a mobile fueller maintenance building that is approved by the local fire marshal.

(iii) Check for flammability decals on all sides. Lettering should be at least 3 inches high. Also check for hazardous materials placards on all sides. The Hazmat number for Jet A trucks should be #1863 and #1203 for 100LL trucks.

(iv) Check the cab for a "No Smoking" sign and the presence of smoking equipment. Ashtrays and cigarette lighters are not to be provided.

(v) Check for two fire extinguishers, accessible from each side of the mobile fueller. Fire extinguishers should be charged, sealed and tagged from the last fire extinguisher inspection. Check dry chemical extinguishers to ensure they are only B-C rated. ABC rated multi-purpose dry chemical extinguishers are not to be used on mobile fuelers as they are highly corrosive to aircraft and can cause significant damage to aircraft engines.

(vi) Check emergency fuel cutoffs to ensure they are boldly marked and operable. There should be an emergency fuel cutoff accessible from each side.

(vii) Check electrical equipment, switches, wiring and tail light lens covers for explosion proof construction and reasonable protection from heat, abrasion or impact which could be an ignition source.

(viii) Check for serviceable bonding wires and clamps.

(ix) Check nozzles for deadman control feature.

(x) Check the vehicle exhaust system for exhaust leaks and for adequate shielding if it extends under the fuel tank portion of the vehicle.

e. **Navigational Aids.** Periodically check the aiming of REILs and Visual Glide Slope Indicators owned by the airport.

f. **Lighting.** The inspector should:

(1) Determine that power generator and circuit resistance tests are being conducted.

(2) Ensure lights with adjustable optical systems are checked for proper aiming.

g. **Obstructions.** The inspector should:

(1) Check to ensure there are no overhead power lines in the aircraft parking areas.

(2) Annually survey trees and other structures near the airport that could affect glide path angles, approach light lanes, or be an obstruction to Part 77 surfaces.

h. **Aircraft Rescue and Fire Fighting.** The inspector should:

(1) Periodically determine if the aircraft rescue and fire fighting equipment is capable of meeting response times, if it is required under Part 139.

- (2) Ensure that recurrent training and hot-fire drills are being conducted as required by Part 139.
- (3) Check to ensure the availability of adequate entry tools.

13. SPECIAL CONDITION INSPECTIONS. Special condition inspections occur after receipt of a complaint or as triggered by an unusual condition or event. A special inspection should be conducted after an accident or incident. Depending upon circumstances, special condition inspections may include the inspection of any of the specific facilities or activities under the other three components. A special condition inspection of airport physical facilities and activities should cover at least the areas described in this section, which are also included in Appendix 4.

a. Pavement Areas. After a rain or thunderstorm, the inspector should check the pavement areas for ponding and edge damming.

b. Markings and Signs. The inspector should:

(1) Determine if markings are visible at night especially when the pavement is wet following a rain.

(2) After construction or maintenance operations, ensure that pavement markings are correct.

c. Safety Areas. The inspector should:

(1) Ensure that the storm sewer system is checked to verify that inlets are not clogged and drainage channels are free of debris. Note any standing water.

(2) Ensure all inlet covers are in place and sewer covers are at grade level.

(3) Conduct a special inspection before reopening a runway or taxiway following any construction or maintenance that has been performed in or around that safety area.

(4) Any time an aircraft has left the pavement and entered a safety area, check to ensure that no ruts or holes have been made by the aircraft tires or by personnel and equipment during the recovery operation.

(5) Check for construction and maintenance activities to ensure that no hazardous conditions have been created (equipment left in safety areas, unacceptable pavement lips created by ground alteration work, ruts from mowing equipment, etc.).

(6) Inspect engineered materials arresting system (EMAS), if installed, for damage and for deterioration.

(7) Physically drive or walk the safety areas to check for any discrepancies.

d. Snow and Ice. Several special inspections may be needed during a winter storm until the airport is back to a normal operation. The inspector should:

(1) Check to ensure that all foreign objects have been picked up after snow and ice removal operations.

(2) If a friction measurement device is available, issue the appropriate numbers obtained from the equipment. Do not attempt to correlate friction measurement numbers with braking action reports. If a friction measurement device is not available, issue to Air Traffic braking action reports.

(3) Conduct a special sign inspection after snowstorms for signs that may have been damaged by plows or by snow thrown by blowers.

e. Construction. The inspector should:

(1) Ensure that construction areas are barricaded and lighted properly.

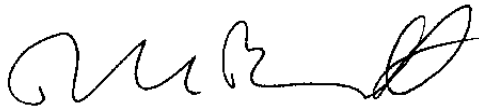
- (2) Check construction equipment to ensure that they are parked within the pre-arranged areas.
- (3) Conduct night inspections to ensure that barricades, warning lighting, and reflectors are adequate to keep aircraft away from the construction area.
- (4) Check the location of construction material and stockpiles to ensure that they are outside of safety areas and do not block any signs.
- (5) Check any movement areas adjacent to construction areas or movement areas traversed by construction vehicles to ensure there is no FOD present.
- (6) Check movement areas around construction sites for potentially confusing marking, lighting, and signs that could cause pilot confusion or result in a runway incursion.

f. Surface Movement Guidance and Control Systems (SMGCS).

(1) For operations below 1,200 feet runway visual range, the inspector should conduct an initial inspection of stop bar lights, runway guard lights, clearance bar lights, taxiway centerline lights, and taxiway edge lights installed on the low visibility routes in accordance with the airport's SMGCS plan.

(2) SMGCS lighting systems that are not electronically monitored should be periodically inspected every 2 to 4 hours for during operations below 1,200 feet to 600 feet. For operations below 600 feet, these inspections should take place every 2 hours. Such inspections should be detailed in the airport's SMGCS plan.

14. CONDITION REPORTING. Alert users of the airport to any unsafe conditions that exists and that could affect their operations. Ensure appropriate NOTAMS are issued for unsafe conditions that are identified during an inspection but cannot be corrected immediately. After reporting NOTAMS to the Flight Service Station, follow-up to ensure that the NOTAMS were processed and transmitted.



David L. Bennett
Director, Office of Airport Safety and Standards

APPENDICES 1–4**SUGGESTED AIRPORT SAFETY SELF-INSPECTION CHECKLISTS**

An airport safety self-inspection checklist should cover the condition of the facilities and equipment on the airport for it to be a part of a good safety inspection program. The checklist should be developed so that it is useful for the airport and its operation. A sketch of the airport is highly recommended to readily identify the location of problems found during the daily inspection.

The suggested checklists consist of a listing of facilities and equipment and a series of conditions that are inspected.

The blank squares indicate the conditions to be evaluated for each facility. A check (√) in one of these squares would indicate that the condition of the facility and equipment was found to be satisfactory. On the other hand, an “x” in one of these squares would indicate that the condition of the facility and equipment was found to be unsatisfactory.

When an unsatisfactory condition is found:

1. An “x” for each applicable square should be entered;
2. A note provided in the Remark/Action Taken section;
3. The location of the condition should be identified in the airport sketch; and
4. Appropriate follow-up action including NOTAMs should be initiated. Corrective action should be documented on either the self-inspection checklists or on a separate work order system.

These checklists are ideal for electronic conversion to PDAs and laptop computers.

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**APPENDIX 1
AIRPORT SAFETY SELF-INSPECTION CHECKLIST**

DATE: _____ DAY: _____

✓ Satisfactory
X Unsatisfactory

Day Inspector/Time: _____ Night Inspector/Time: _____

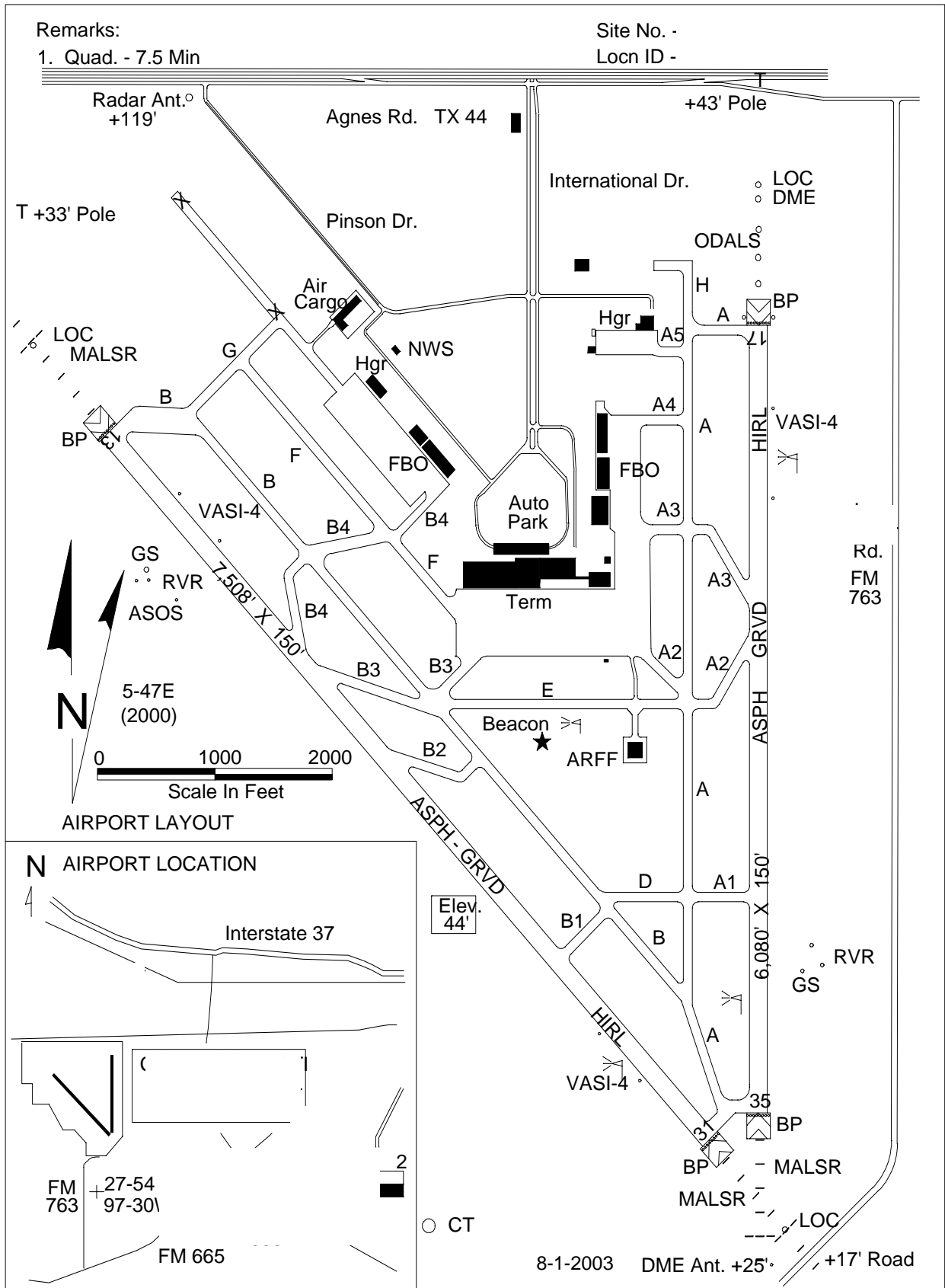
FACILITIES	CONDITIONS	D	N	REMARKS	RESOLVED BY (Date/Initials)
Pavement Areas	Pavement lips over 3"				
	Hole – 5" diam. 3" deep				
	Cracks/spalling/heaves				
	FOD: gravel/debris/sand				
	Rubber deposits				
	Ponding/edge dams				
Safety Areas	Ruts/humps/erosion				
	Drainage/construction				
	Support equipment/aircraft				
	Frangible bases				
	Unauthorized objects				
Markings	Clearly visible/standard				
	Runway markings				
	Taxiway markings				
	Holding position markings				
	Glass beads				
Signs	Standard/meet Sign Plan				
	Obscured/operable				
	Damaged/retroreflective				

FACILITIES	CONDITIONS	D	N	REMARKS	RESOLVED BY (Date/Initials)
Lighting	Obscured/dirty/operable				
	Damaged/missing				
	Faulty aim/adjustment				
	Runway lighting				
	Taxiway lighting				
	Pilot control lighting				
Navigational Aids	Rotating beacon operable				
	Wind indicators				
	RENLS/VGSI systems				
Obstructions	Obstruction lights operable				
	Cranes/trees				
Fueling Operations	Fencing/gates/signs				
	Fuel marking/labeling				
	Fire extinguishers				
	Frayed wires				
	Fuel leaks/vegetation				
Snow & Ice	Surface conditions				
	Snowbank clearances				
	Lights & signs obscured				
	NAVAIDs				
	Fire access				

FACILITIES	CONDITIONS	D	N	REMARKS	RESOLVED BY (Date/Initials)
Construction	Barricades/lights				
	Equipment parking				
	Material stockpiles				
	Confusing signs/markings				
Aircraft Rescue and Fire Fighting	Equipment/crew availability				
	Communications/alarms				
	Response routes affected				
Public Protection	Fencing/gates/signs				
	Jet blast problems				
Wildlife Hazards	Wildlife present/location				
	Complying with WHMP				
	Dead birds				

Comments/Remarks: _____

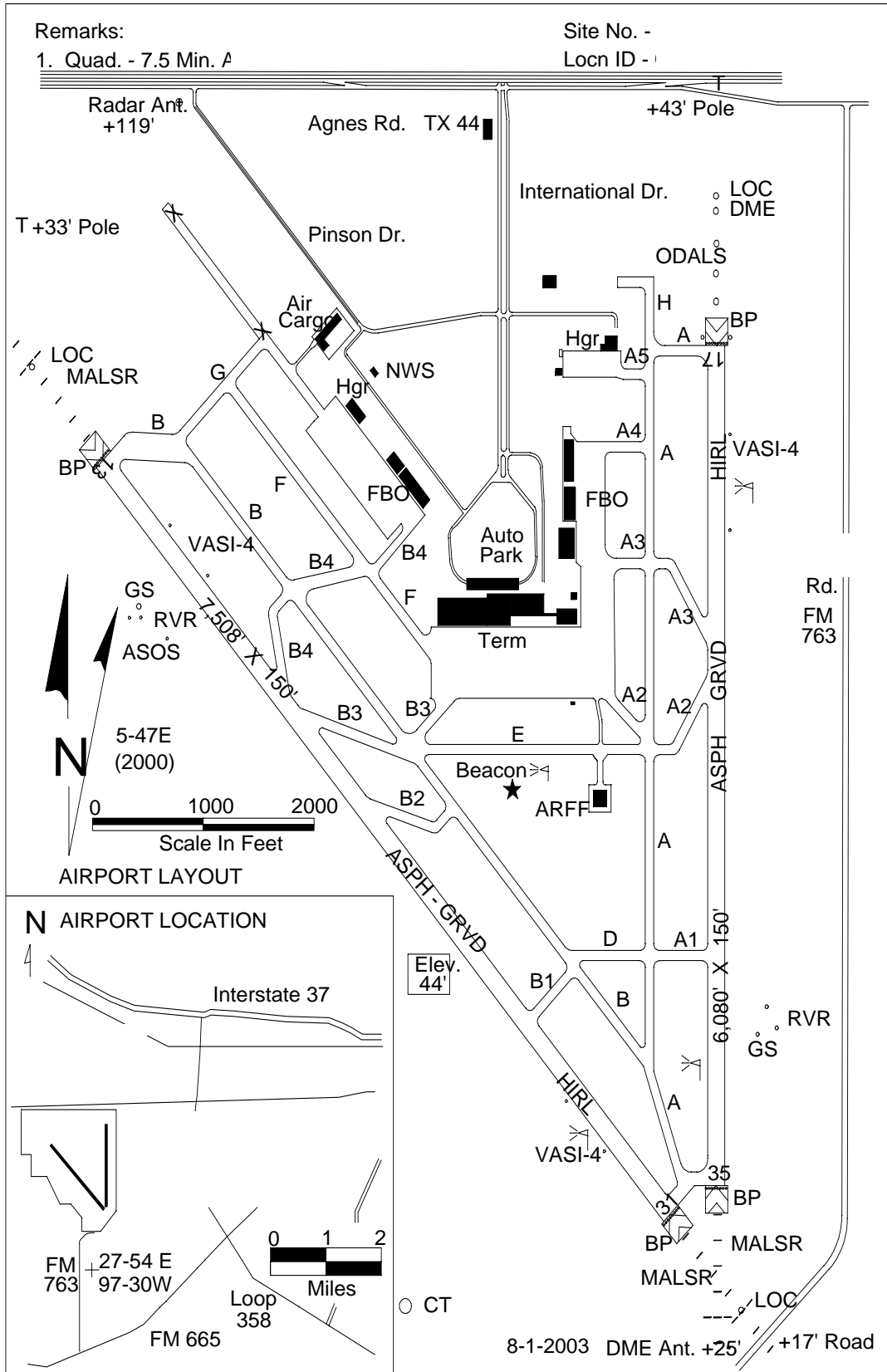
Airfield Map on Reverse Side



**APPENDIX 2
CONTINUOUS SURVEILLANCE CHECKLIST**

<input checked="" type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory			
DATE: _____		DAY: _____	
TIME: _____		INSPECTOR: _____	
FACILITIES	CONDITIONS	√	REMARKS/ACTIONS TAKEN
Ground Vehicles	Rules/Procedures Followed	<input type="checkbox"/>	
		<input type="checkbox"/>	
Fueling Operations	Fire/Explosion Hazards	<input type="checkbox"/>	
	Signing/No smoking	<input type="checkbox"/>	
		<input type="checkbox"/>	
Snow & Ice	Surface Conditions	<input type="checkbox"/>	
		<input type="checkbox"/>	
Construction	Safety Plan	<input type="checkbox"/>	
	Runway Incursions	<input type="checkbox"/>	
	Runway & Taxiway Use	<input type="checkbox"/>	
	FOD	<input type="checkbox"/>	
Public Protection	Unauthorized Persons	<input type="checkbox"/>	
	Unauthorized Vehicles	<input type="checkbox"/>	
	Gates clear	<input type="checkbox"/>	
		<input type="checkbox"/>	
Wildlife Hazards	Birds/Animals	<input type="checkbox"/>	
		<input type="checkbox"/>	
Miscellaneous	Pedestrians in Movement Areas	<input type="checkbox"/>	
	Passenger Load/Unload	<input type="checkbox"/>	
	Debris in Movement Area	<input type="checkbox"/>	
		<input type="checkbox"/>	
Additional Remarks			

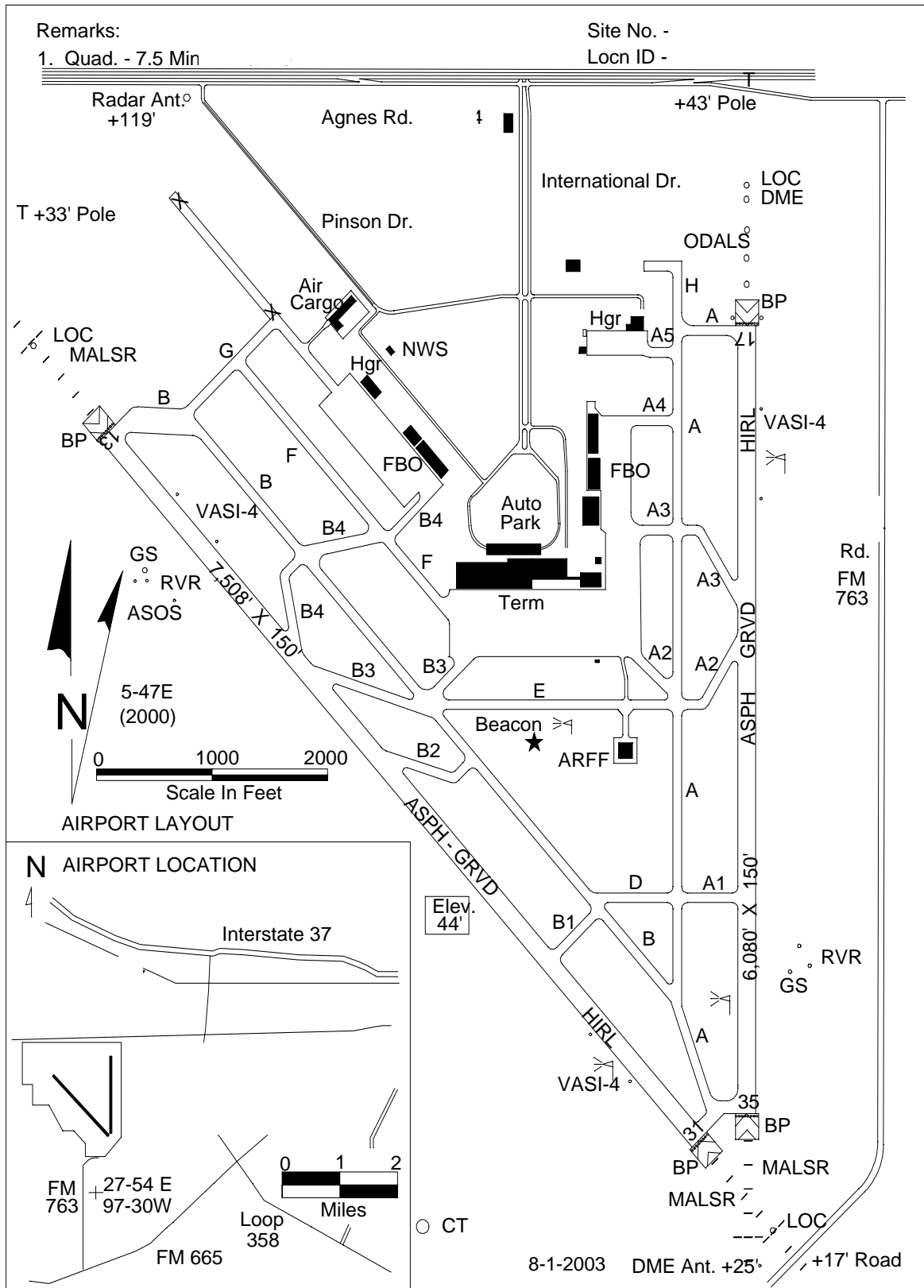
Airfield Map on Reverse Side



**APPENDIX 3
PERIODIC CONDITION INSPECTION CHECKLIST**

DATE: _____ DAY: _____		√ Satisfactory	
TIME: _____ INSPECTOR: _____		X Unsatisfactory	
FACILITIES	CONDITIONS	√	REMARKS/ACTIONS TAKEN
Pavement Areas	Rubber Deposits		
	Polishing		
Markings and Signs	Visible		
	Standards		
Fueling Operations	Physical Facilities		
	Mobile Fuelers		
	Fire Extinguishers		
	Fuel Marking/Labeling		
	Frayed Wiring		
Navigational Aids	RENs/VGSI Aiming		
Lighting	Power Generator Check		
	Circuit Resistance Test		
	Aim/Adjustment		
Obstructions	Surveyed Trees/Structures		
	Overhead Power Lines		
Aircraft Rescue and Fire Fighting	Response Times		
	Live Fire Drills		
	Training		
Additional Remarks			

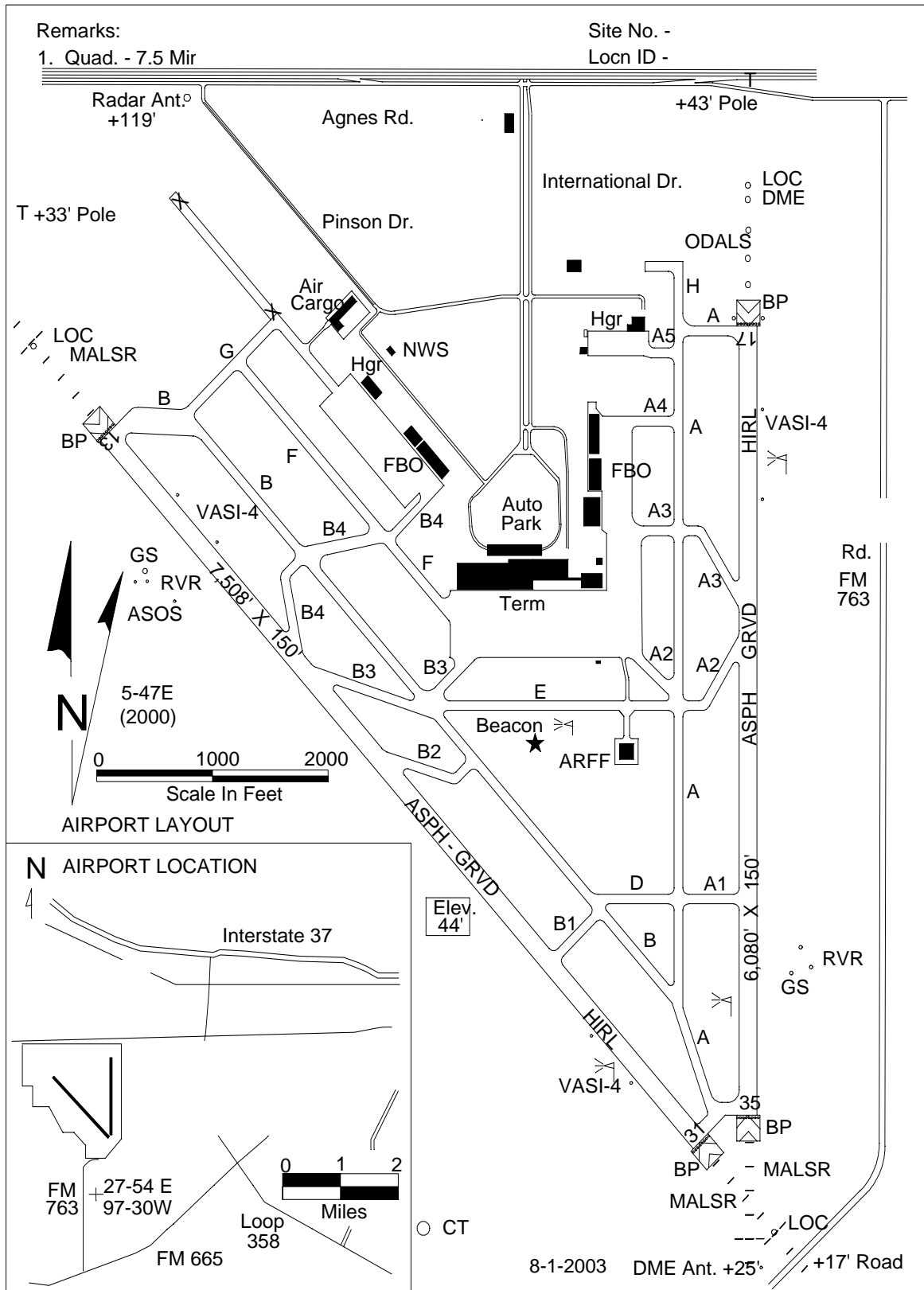
Airfield Map on Reverse Side



**APPENDIX 4
SPECIAL INSPECTION CHECKLIST**

DATE: _____ DAY: _____		√ Satisfactory	
TIME: _____ INSPECTOR: _____		X Unsatisfactory	
FACILITIES	CONDITIONS	√	REMARKS/ACTIONS TAKEN
Pavement Areas	Ponding/Edge Dams		
Markings And Signs	Visible after rain		
	Standards after Construction		
Safety Areas	Drainage		
	Reopening Runways		
	Reopening Taxiways		
Snow and Ice	Surface conditions		
	Snowbank clearance		
	Lights & Signs Obscured		
	FOD		
	Braking Action/MU Reports		
Construction	Barricades		
	Construction Lights		
	Equipment Parking		
SMGCS	SMGCS Lighting		
Additional Remarks			

Airfield Map on Reverse Side



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APPENDIX 5B

QUARTERLY INSPECTION – FUEL STORAGE AREAS

Inspector: _____ Fueling Agent: _____ Date: _____

S – Satisfactory U – Unsatisfactory R – Remark Below	Jet A Section			100LL Section			Other _____		
	S	U	R	S	U	R	S	U	R
Fencing/Locks/Signs									
Piping protected from vehicles									
No Smoking signs posted									
Deadman Controls for loading stations									
2 Fire Extinguishers – Inspected/Accessible									
Boldly Marked Emergency Cutoffs – Location									
No Fuel Leaks									
Bonding wire/clips at loading stations/operable									
Piping/Pumps bonded and grounded									
No vegetation or materials to spread fire									
No evidence of Smoking									
Hoses in good condition									
Explosion Proof Electrical Equipment									
Remarks: _____									

**APPENDIX C
ADVISORY CIRCULAR
150/5370-2G**

**BID DOCUMENTS
HANGAR DEVELOPMENTS
MARIANNA MUNICIPAL AIRPORT, MARIANNA, FLORIDA**



U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

Subject: Operational Safety on
Airports During Construction

Date: 12/13/2017
Initiated By: AAS-100

AC No: 150/5370-2G
Change:

1 **Purpose.**

This AC sets forth guidelines for operational safety on airports during construction.

2 **Cancellation.**

This AC cancels AC 150/5370-2F, *Operational Safety on Airports during Construction*, dated September 29, 2011.

3 **Application.**

This AC assists airport operators in complying with Title 14 Code of Federal Regulations (CFR) Part 139, *Certification of Airports*. For those certificated airports, this AC provides one way, but not the only way, of meeting those requirements. The use of this AC is mandatory for those airport construction projects receiving funds under the Airport Improvement Program (AIP). See Grant Assurance No. 34, *Policies, Standards, and Specifications*. While we do not require non-certificated airports without grant agreements or airports using Passenger Facility Charge (PFC) Program funds for construction projects to adhere to these guidelines, we recommend that they do so to help these airports maintain operational safety during construction.

4 **Related Documents.**

ACs and Orders referenced in the text of this AC do not include a revision letter, as they refer to the latest version. [Appendix A](#) contains a list of reading material on airport construction, design, and potential safety hazards during construction, as well as instructions for obtaining these documents.

5 **Principal Changes.**

The AC incorporates the following principal changes:

1. Notification about impacts to both airport owned and FAA-owned NAVAIDs was added. See paragraph [2.13.5.3](#), NAVAIDs.

2. Guidance for the use of orange construction signs was added. See paragraph 2.18.4.2, Temporary Signs.
3. Open trenches or excavations may be permitted in the taxiway safety area while the taxiway is open to aircraft operations, subject to restrictions. See paragraph 2.22.3.4, Excavations.
4. Guidance for temporary shortened runways and displaced thresholds has been enhanced. See Figure 2-1 and Figure 2-2.
5. Figures have been improved and a new Appendix F on the placement of orange construction signs has been added.

Hyperlinks (allowing the reader to access documents located on the internet and to maneuver within this document) are provided throughout this document and are identified with underlined text. When navigating within this document, return to the previously viewed page by pressing the “ALT” and “ ← ” keys simultaneously.

Figures in this document are schematic representations and are not to scale.

6 **Use of Metrics.**

Throughout this AC, U.S. customary units are used followed with “soft” (rounded) conversion to metric units. The U.S. customary units govern.

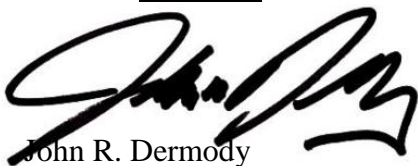
7 **Where to Find this AC.**

You can view a list of all ACs at

http://www.faa.gov/regulations_policies/advisory_circulars/. You can view the Federal Aviation Regulations at http://www.faa.gov/regulations_policies/faa_regulations/.

8 **Feedback on this AC.**

If you have suggestions for improving this AC, you may use the Advisory Circular Feedback form at the end of this AC.



John R. Dermody

Director of Airport Safety and Standards

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CHAPTER 1. PLANNING AN AIRFIELD CONSTRUCTION PROJECT

1.1 Overview.

Airports are complex environments, and procedures and conditions associated with construction activities often affect aircraft operations and can jeopardize operational safety. Safety considerations are paramount and may make operational impacts unavoidable. However, careful planning, scheduling, and coordination of construction activities can minimize disruption of normal aircraft operations and avoid situations that compromise the airport's operational safety. The airport operator must understand how construction activities and aircraft operations affect one another to be able to develop an effective plan to complete the project. While the guidance in this AC is primarily used for construction operations, the concepts, methods and procedures described may also enhance the day-to-day airport maintenance operations, such as lighting maintenance and snow removal operations.

1.2 Plan for Safety.

Safety, maintaining aircraft operations, and construction costs are all interrelated. Since safety must not be compromised, the airport operator must strike a balance between maintaining aircraft operations and construction costs. This balance will vary widely depending on the operational needs and resources of the airport and will require early coordination with airport users and the FAA. As the project design progresses, the necessary construction locations, activities, and associated costs will be identified and their impact to airport operations must be assessed. Adjustments are made to the proposed construction activities, often by phasing the project, and/or to airport operations to maintain operational safety. This planning effort will ultimately result in a project Construction Safety and Phasing Plan (CSPP). The development of the CSPP takes place through the following five steps:

1.2.1 Identify Affected Areas.

The airport operator must determine the geographic areas on the airport affected by the construction project. Some, such as a runway extension, will be defined by the project. Others may be variable, such as the location of haul routes and material stockpiles.

1.2.2 Describe Current Operations.

Identify the normal airport operations in each affected area for each phase of the project. This becomes the baseline from which the impact on operations by construction activities can be measured. This should include a narrative of the typical users and aircraft operating within the affected areas. It should also include information related to airport operations: the Aircraft Approach Category (AAC) and Airplane Design Group (ADG) of the airplanes that operate on each runway; the ADG and Taxiway Design Group (TDG)¹ for each affected taxiway; designated approach visibility minimums;

¹ Find Taxiway Design Group information in [AC 150/5300-13, Airport Design](#).

available approach and departure procedures; most demanding aircraft; declared distances; available air traffic control services; airport Surface Movement Guidance and Control System (SMGCS) plan; and others. The applicable seasons, days and times for certain operations should also be identified as applicable.

1.2.3 Allow for Temporary Changes to Operations.

To the extent practical, current airport operations should be maintained during the construction. In consultation with airport users, Aircraft Rescue and Fire Fighting (ARFF) personnel, and FAA Air Traffic Organization (ATO) personnel, the airport operator should identify and prioritize the airport's most important operations. The construction activities should be planned, through project phasing if necessary, to safely accommodate these operations. When the construction activities cannot be adjusted to safely maintain current operations, regardless of their importance, then the operations must be revised accordingly. Allowable changes include temporary revisions to approach procedures, restricting certain aircraft to specific runways and taxiways, suspension of certain operations, decreased weights for some aircraft due to shortened runways, and other changes. An example of a table showing temporary operations versus current operations is shown in Appendix E.

1.2.4 Take Required Measures to Revise Operations.

Once the level and type of aircraft operations to be maintained are identified, the airport operator must determine the measures required to safely conduct the planned operations during the construction. These measures will result in associated costs, which can be broadly interpreted to include not only direct construction costs, but also loss of revenue from impacted operations. Analysis of costs may indicate a need to reevaluate allowable changes to operations. As aircraft operations and allowable changes will vary widely among airports, this AC presents general guidance on those subjects.

1.2.5 Manage Safety Risk.

The FAA is committed to incorporating proactive safety risk management (SRM) tools into its decision-making processes. FAA Order 5200.11, *FAA Airports (ARP) Safety Management System (SMS)*, requires the FAA to conduct a Safety Assessment for certain triggering actions. Certain airport projects may require the airport operator to provide a Project Proposal Summary to help the FAA determine whether a Safety Assessment is required prior to FAA approval of the CSPP. The airport operator must coordinate with the appropriate FAA Airports Regional or District Office early in the development of the CSPP to determine the need for a Safety Risk Assessment. If the FAA requires an assessment, the airport operator must at a minimum:

1. Notify the appropriate FAA Airports Regional or District Office during the project "scope development" phase of any project requiring a CSPP.
2. Provide documents identified by the FAA as necessary to conduct SRM.
3. Participate in the SRM process for airport projects.
4. Provide a representative to participate on the SRM panel.

5. Ensure that all applicable SRM identified risks elements are recorded and mitigated within the CSPP.

1.3 **Develop a Construction Safety and Phasing Plan (CSPP).**

Development of an effective CSPP will require familiarity with many other documents referenced throughout this AC. See Appendix A for a list of related reading material.

1.3.1 List Requirements.

A CSPP must be developed for each on-airfield construction project funded by the Airport Improvement Program (AIP) or located on an airport certificated under Part 139. For on-airfield construction projects at Part 139 airports funded without AIP funds, the preparation of a CSPP represents an acceptable method the certificate holder may use to meet Part 139 requirements during airfield construction activity. As per FAA Order 5200.11, projects that require Safety Assessments do not include construction, rehabilitation, or change of any facility that is entirely outside the air operations area, does not involve any expansion of the facility envelope and does not involve construction equipment, haul routes or placement of material in locations that require access to the air operations area, increase the facility envelope, or impact line-of-sight. Such facilities may include passenger terminals and parking or other structures. However, extraordinary circumstances may trigger the need for a Safety Assessment and a CSPP. The CSPP is subject to subsequent review and approval under the FAA's Safety Risk Management procedures (see paragraph 1.2.5).

1.3.2 Prepare a Safety Plan Compliance Document (SPCD).

The Safety Plan Compliance Document (SPCD) details how the contractor will comply with the CSPP. Also, it will not be possible to determine all safety plan details (for example specific hazard equipment and lighting, contractor's points of contact, construction equipment heights) during the development of the CSPP. The successful contractor must define such details by preparing an SPCD that the airport operator reviews for approval prior to issuance of a notice-to-proceed. The SPCD is a subset of the CSPP, similar to how a shop drawing review is a subset to the technical specifications.

1.3.3 Assume Responsibility for the CSPP.

The airport operator is responsible for establishing and enforcing the CSPP. The airport operator may use the services of an engineering consultant to help develop the CSPP. However, writing the CSPP cannot be delegated to the construction contractor. Only those details the airport operator determines cannot be addressed before contract award are developed by the contractor and submitted for approval as the SPCD. The SPCD does not restate nor propose differences to provisions already addressed in the CSPP.

1.4 **Who Is Responsible for Safety During Construction?**

1.4.1 Establish a Safety Culture.

Everyone has a role in operational safety on airports during construction: the airport operator, the airport's consultants, the construction contractor and subcontractors, airport users, airport tenants, ARFF personnel, Air Traffic personnel, including Technical Operations personnel, FAA Airports Division personnel, and others, such as military personnel at any airport supporting military operations (e.g. national guard or a joint use facility). Close communication and coordination between all affected parties is the key to maintaining safe operations. Such communication and coordination should start at the project scoping meeting and continue through the completion of the project. The airport operator and contractor should conduct onsite safety inspections throughout the project and immediately remedy any deficiencies, whether caused by negligence, oversight, or project scope change.

1.4.2 Assess Airport Operator's Responsibilities.

An airport operator has overall responsibility for all activities on an airport, including construction. This includes the predesign, design, preconstruction, construction, and inspection phases. Additional information on the responsibilities listed below can be found throughout this AC. The airport operator must:

- 1.4.2.1 Develop a CSPP that complies with the safety guidelines of Chapter 2, Construction Safety and Phasing Plans, and Chapter 3, Guidelines for Writing a CSPP. The airport operator may develop the CSPP internally or have a consultant develop the CSPP for approval by the airport operator. For tenant sponsored projects, approve a CSPP developed by the tenant or its consultant.
- 1.4.2.2 Require, review and approve the SPCD by the contractor that indicates how it will comply with the CSPP and provides details that cannot be determined before contract award.
- 1.4.2.3 Convene a preconstruction meeting with the construction contractor, consultant, airport employees and, if appropriate, tenant sponsor and other tenants to review and discuss project safety before beginning construction activity. The appropriate FAA representatives should be invited to attend the meeting. See AC 150/5370-12, Quality Management for Federally Funded Airport Construction Projects. (Note “FAA” refers to the Airports Regional or District Office, the Air Traffic Organization, Flight Standards Service, and other offices that support airport operations, flight regulations, and construction/environmental policies.)
- 1.4.2.4 Ensure contact information is accurate for each representative/point of contact identified in the CSPP and SPCD.
- 1.4.2.5 Hold weekly or, if necessary, daily safety meetings with all affected parties to coordinate activities.
- 1.4.2.6 Notify users, ARFF personnel, and FAA ATO personnel of construction and conditions that may adversely affect the operational safety of the airport via Notices to Airmen (NOTAM) and other methods, as appropriate. Convene a meeting for review and discussion if necessary.
- 1.4.2.7 Ensure construction personnel know applicable airport procedures and changes to those procedures that may affect their work.
- 1.4.2.8 Ensure that all temporary construction signs are located per the scheduled list for each phase of the project.
- 1.4.2.9 Ensure construction contractors and subcontractors undergo training required by the CSPP and SPCD.
- 1.4.2.10 Ensure vehicle and pedestrian operations addressed in the CSPP and SPCD are coordinated with airport tenants, the airport traffic control tower (ATCT), and construction contractors.
- 1.4.2.11 At certificated airports, ensure each CSPP and SPCD is consistent with Part 139.

- 1.4.2.12 Conduct inspections sufficiently frequently to ensure construction contractors and tenants comply with the CSPP and SPCD and that there are no altered construction activities that could create potential safety hazards.
 - 1.4.2.13 Take immediate action to resolve safety deficiencies.
 - 1.4.2.14 At airports subject to 49 CFR Part 1542, *Airport Security*, ensure construction access complies with the security requirements of that regulation.
 - 1.4.2.15 Notify appropriate parties when conditions exist that invoke provisions of the CSPP and SPCD (for example, implementation of low-visibility operations).
 - 1.4.2.16 Ensure prompt submittal of a Notice of Proposed Construction or Alteration (Form 7460-1) for conducting an aeronautical study of potential obstructions such as tall equipment (cranes, concrete pumps, other), stock piles, and haul routes. A separate form may be filed for each potential obstruction, or one form may be filed describing the entire construction area and maximum equipment height. In the latter case, a separate form must be filed for any object beyond or higher than the originally evaluated area/height. The FAA encourages online submittal of forms for expediency at <https://oeaaa.faa.gov/oeaaa/external/portal.jsp>. The appropriate FAA Airports Regional or District Office can provide assistance in determining which objects require an aeronautical study.
 - 1.4.2.17 Ensure prompt transmission of the Airport Sponsor Strategic Event Submission, FAA Form 6000-26, located at https://oeaaa.faa.gov/oeaaa/external/content/AIRPORT_SPONSOR_STRATEGIC_EVENT_SUBMISSION_FORM.pdf, to assure proper coordination for NAS Strategic Interruption per Service Level Agreement with ATO.
 - 1.4.2.18 Promptly notify the FAA Airports Regional or District Office of any proposed changes to the CSPP prior to implementation of the change. Changes to the CSPP require review and approval by the airport operator and the FAA. The FAA Airports Regional or District office will determine if further coordination within the FAA is needed. Coordinate with appropriate local and other federal government agencies, such as Environmental Protection Agency (EPA), Occupational Safety and Health Administration (OSHA), Transportation Security Administration (TSA), and the state environmental agency.
- 1.4.3 Define Construction Contractor's Responsibilities.
The contractor is responsible for complying with the CSPP and SPCD. The contractor must:

- 1.4.3.1 Submit a Safety Plan Compliance Document (SPCD) to the airport operator describing how it will comply with the requirements of the CSPP and supply any details that could not be determined before contract award. The SPCD must include a certification statement by the contractor, indicating an understanding of the operational safety requirements of the CSPP and the assertion of compliance with the approved CSPP and SPCD unless written approval is granted by the airport operator. Any construction practice proposed by the contractor that does not conform to the CSPP and SPCD may impact the airport's operational safety and will require a revision to the CSPP and SPCD and re-coordination with the airport operator and the FAA in advance.
- 1.4.3.2 Have available at all times copies of the CSPP and SPCD for reference by the airport operator and its representatives, and by subcontractors and contractor employees.
- 1.4.3.3 Ensure that construction personnel are familiar with safety procedures and regulations on the airport. Provide a point of contact who will coordinate an immediate response to correct any construction-related activity that may adversely affect the operational safety of the airport. Many projects will require 24-hour coverage.
- 1.4.3.4 Identify in the SPCD the contractor's on-site employees responsible for monitoring compliance with the CSPP and SPCD during construction. At least one of these employees must be on-site when active construction is taking place.
- 1.4.3.5 Conduct sufficient inspections to ensure construction personnel comply with the CSPP and SPCD and that there are no altered construction activities that could create potential safety hazards.
- 1.4.3.6 Restrict movement of construction vehicles and personnel to permitted construction areas by flagging, barricading, erecting temporary fencing, or providing escorts, as appropriate, and as specified in the CSPP and SPCD.
- 1.4.3.7 Ensure that no contractor employees, employees of subcontractors or suppliers, or other persons enter any part of the air operations area (AOA) from the construction site unless authorized.
- 1.4.3.8 Ensure prompt submittal through the airport operator of Form 7460-1 for the purpose of conducting an aeronautical study of contractor equipment such as tall equipment (cranes, concrete pumps, and other equipment), stock piles, and haul routes when different from cases previously filed by the airport operator. The FAA encourages online submittal of forms for expediency at <https://oeaaa.faa.gov/oeaaa/external/portal.jsp>.

- 1.4.3.9 Ensure that all necessary safety mitigations are understood by all parties involved, and any special requirements of each construction phase will be fulfilled per the approved timeframe.
- 1.4.3.10 Participate in pre-construction meetings to review construction limits, safety mitigations, NOTAMs, and understand all special airport operational needs during each phase of the project.

1.4.4 Define Tenant's Responsibilities.

If planning construction activities on leased property, Airport tenants, such as airline operators, fixed base operators, and FAA ATO/Technical Operations sponsoring construction are strongly encouraged to:

1. Develop, or have a consultant develop, a project specific CSPP and submit it to the airport operator. The airport operator may forgo a complete CSPP submittal and instead incorporate appropriate operational safety principles and measures addressed in the advisory circular within their tenant lease agreements.
2. In coordination with its contractor, develop an SPCD and submit it to the airport operator for approval issued prior to issuance of a Notice to Proceed.
3. Ensure that construction personnel are familiar with safety procedures and regulations on the airport during all phases of the construction.
4. Provide a point of contact of who will coordinate an immediate response to correct any construction-related activity that may adversely affect the operational safety of the airport.
5. Identify in the SPCD the contractor's on-site employees responsible for monitoring compliance with the CSPP and SPCD during construction. At least one of these employees must be on-site when active construction is taking place.
6. Ensure that no tenant or contractor employees, employees of subcontractors or suppliers, or any other persons enter any part of the AOA from the construction site unless authorized.
7. Restrict movement of construction vehicles to construction areas by flagging and barricading, erecting temporary fencing, or providing escorts, as appropriate, as specified in the CSPP and SPCD.
8. Ensure prompt submittal through the airport operator of Form 7460-1 for conducting an aeronautical study of contractor equipment such as tall equipment (cranes, concrete pumps, other), stock piles, and haul routes. The FAA encourages online submittal of forms for expediency at <https://oeaaa.faa.gov/oeaaa/external/portal.jsp>.
9. Participate in pre-construction meetings to review construction limits, safety mitigations, NOTAMs, and understand all special airport operational needs during each phase of the project.

CHAPTER 2. CONSTRUCTION SAFETY AND PHASING PLANS

2.1 **Overview.**

Aviation safety is the primary consideration at airports, especially during construction. The airport operator's CSPP and the contractor's Safety Plan Compliance Document (SPCD) are the primary tools to ensure safety compliance when coordinating construction activities with airport operations. These documents identify all aspects of the construction project that pose a potential safety hazard to airport operations and outline respective mitigation procedures for each hazard. They must provide information necessary for the Airport Operations department to conduct airfield inspections and expeditiously identify and correct unsafe conditions during construction. All aviation safety provisions included within the project drawings, contract specifications, and other related documents must also be reflected in the CSPP and SPCD.

2.2 **Assume Responsibility.**

Operational safety on the airport remains the airport operator's responsibility at all times. The airport operator must develop, certify, and submit for FAA approval each CSPP. It is the airport operator's responsibility to apply the requirements of the FAA approved CSPP. The airport operator must revise the CSPP when conditions warrant changes and must submit the revised CSPP to the FAA for approval. The airport operator must also require and approve a SPCD from the project contractor.

2.3 **Submit the CSPP.**

Construction Safety and Phasing Plans should be developed concurrently with the project design. Milestone versions of the CSPP should be submitted for review and approval as follows. While these milestones are not mandatory, early submission will help to avoid delays. Submittals are preferred in 8.5 × 11 inch or 11 × 17 inch format for compatibility with the FAA's Obstruction Evaluation / Airport Airspace Analysis (OE / AAA) process.

2.3.1 Submit an Outline/Draft.

By the time approximately 25% to 30% of the project design is completed, the principal elements of the CSPP should be established. Airport operators are encouraged to submit an outline or draft, detailing all CSPP provisions developed to date, to the FAA for review at this stage of the project design.

2.3.2 Submit a CSPP.

The CSPP should be formally submitted for FAA approval when the project design is 80 percent to 90 percent complete. Since provisions in the CSPP will influence contract costs, it is important to obtain FAA approval in time to include all such provisions in the procurement contract.

2.3.3 Submit an SPCD.

The contractor should submit the SPCD to the airport operator for approval to be issued prior to the Notice to Proceed.

2.3.4 Submit CSPP Revisions.

All revisions to a previously approved CSPP must be re-submitted to the FAA for review and approval/disapproval action.

2.4 **Meet CSPP Requirements.**

2.4.1 To the extent possible, the CSPP should address the following as outlined in Chapter 3, Guidelines for Writing a CSPP. Details that cannot be determined at this stage are to be included in the SPCD.

1. Coordination.
 - a. Contractor progress meetings.
 - b. Scope or schedule changes.
 - c. FAA ATO coordination.
2. Phasing.
 - a. Phase elements.
 - b. Construction safety drawings.
3. Areas and operations affected by the construction activity.
 - a. Identification of affected areas.
 - b. Mitigation of effects.
4. Protection of navigation aids (NAVAIDs).
5. Contractor access.
 - a. Location of stockpiled construction materials.
 - b. Vehicle and pedestrian operations.
6. Wildlife management.
 - a. Trash.
 - b. Standing water.
 - c. Tall grass and seeds.
 - d. Poorly maintained fencing and gates.
 - e. Disruption of existing wildlife habitat.
7. Foreign Object Debris (FOD) management.
8. Hazardous materials (HAZMAT) management.
9. Notification of construction activities.

- a. Maintenance of a list of responsible representatives/ points of contact.
 - b. NOTAM.
 - c. Emergency notification procedures.
 - d. Coordination with ARFF Personnel.
 - e. Notification to the FAA.
10. Inspection requirements.
 - a. Daily (or more frequent) inspections.
 - b. Final inspections.
 11. Underground utilities.
 12. Penalties.
 13. Special conditions.
 14. Runway and taxiway visual aids. Marking, lighting, signs, and visual NAVAIDs.
 - a. General.
 - b. Markings.
 - c. Lighting and visual NAVAIDs.
 - d. Signs, temporary, including orange construction signs, and permanent signs.
 15. Marking and signs for access routes.
 16. Hazard marking and lighting.
 - a. Purpose.
 - b. Equipment.
 17. Work zone lighting for nighttime construction (if applicable).
 18. Protection of runway and taxiway safety areas, object free areas, obstacle free zones, and approach/departure surfaces.
 - a. Runway Safety Area (RSA).
 - b. Runway Object Free Area (ROFA).
 - c. Taxiway Safety Area (TSA). Provide details for any adjustments to Taxiway Safety Area width to allow continued operation of smaller aircraft. See paragraph 2.22.3.
 - d. Taxiway Object Free Area (TOFA). Provide details for any continued aircraft operations while construction occurs within the TOFA. See paragraph 2.22.4.
 - e. Obstacle Free Zone (OFZ).
 - f. Runway approach/departure surfaces.
 19. Other limitations on construction.
 - a. Prohibitions.

b. Restrictions.

2.4.2 The Safety Plan Compliance Document (SPCD) should include a general statement by the construction contractor that he/she has read and will abide by the CSPP. In addition, the SPCD must include all supplemental information that could not be included in the CSPP prior to the contract award. The contractor statement should include the name of the contractor, the title of the project CSPP, the approval date of the CSPP, and a reference to any supplemental information (that is, “I, (Name of Contractor), have read the (Title of Project) CSPP, approved on (Date), and will abide by it as written and with the following additions as noted:”). The supplemental information in the SPCD should be written to match the format of the CSPP indicating each subject by corresponding CSPP subject number and title. If no supplemental information is necessary for any specific subject, the statement, “No supplemental information,” should be written after the corresponding subject title. The SPCD should not duplicate information in the CSPP:

1. Coordination. Discuss details of proposed safety meetings with the airport operator and with contractor employees and subcontractors.
2. Phasing. Discuss proposed construction schedule elements, including:
 - a. Duration of each phase.
 - b. Daily start and finish of construction, including “night only” construction.
 - c. Duration of construction activities during:
 - i. Normal runway operations.
 - ii. Closed runway operations.
 - iii. Modified runway “Aircraft Reference Code” usage.
3. Areas and operations affected by the construction activity. These areas and operations should be identified in the CSPP and should not require an entry in the SPCD.
4. Protection of NAVAIDs. Discuss specific methods proposed to protect operating NAVAIDs.
5. Contractor access. Provide the following:
 - a. Details on how the contractor will maintain the integrity of the airport security fence (gate guards, daily log of construction personnel, and other).
 - b. Listing of individuals requiring driver training (for certificated airports and as requested).
 - c. Radio communications.
 - i. Types of radios and backup capabilities.
 - ii. Who will be monitoring radios.
 - iii. Who to contact if the ATCT cannot reach the contractor’s designated person by radio.

- d. Details on how the contractor will escort material delivery vehicles.
6. Wildlife management. Discuss the following:
 - a. Methods and procedures to prevent wildlife attraction.
 - b. Wildlife reporting procedures.
7. Foreign Object Debris (FOD) management. Discuss equipment and methods for control of FOD, including construction debris and dust.
8. Hazardous Materials (HAZMAT) management. Discuss equipment and methods for responding to hazardous spills.
9. Notification of construction activities. Provide the following:
 - a. Contractor points of contact.
 - b. Contractor emergency contact.
 - c. Listing of tall or other requested equipment proposed for use on the airport and the timeframe for submitting 7460-1 forms not previously submitted by the airport operator.
 - d. Batch plant details, including 7460-1 submittal.
10. Inspection requirements. Discuss daily (or more frequent) inspections and special inspection procedures.
11. Underground utilities. Discuss proposed methods of identifying and protecting underground utilities.
12. Penalties. Penalties should be identified in the CSPP and should not require an entry in the SPCD.
13. Special conditions. Discuss proposed actions for each special condition identified in the CSPP.
14. Runway and taxiway visual aids. Including marking, lighting, signs, and visual NAVAIDs. Discuss proposed visual aids including the following:
 - a. Equipment and methods for covering signage and airfield lights.
 - b. Equipment and methods for temporary closure markings (paint, fabric, other).
 - c. Temporary orange construction signs.
 - d. Types of temporary Visual Guidance Slope Indicators (VGSI).
15. Marking and signs for access routes. Discuss proposed methods of demarcating access routes for vehicle drivers.
16. Hazard marking and lighting. Discuss proposed equipment and methods for identifying excavation areas.
17. Work zone lighting for nighttime construction (if applicable). Discuss proposed equipment, locations, aiming, and shielding to prevent interference with air traffic control and aircraft operations.

18. Protection of runway and taxiway safety areas, object free areas, obstacle free zones, and approach/departure surfaces. Discuss proposed methods of identifying, demarcating, and protecting airport surfaces including:
 - a. Equipment and methods for maintaining Taxiway Safety Area standards.
 - b. Equipment and methods to ensure the safe passage of aircraft where Taxiway Safety Area or Taxiway Object Free Area standards cannot be maintained.
 - c. Equipment and methods for separation of construction operations from aircraft operations, including details of barricades.
19. Other limitations on construction should be identified in the CSPP and should not require an entry in the SPCD.

2.5 **Coordination.**

Airport operators, or tenants responsible for design, bidding and conducting construction on their leased properties, should ensure at all project developmental stages, such as predesign, prebid, and preconstruction conferences, they capture the subject of airport operational safety during construction (see [AC 150/5370-12, *Quality Management for Federally Funded Airport Construction Projects*](#)). In addition, the following should be coordinated as required:

2.5.1 Progress Meetings.

Operational safety should be a standing agenda item for discussion during progress meetings throughout the project developmental stages.

2.5.2 Scope or Schedule Changes.

Changes in the scope or duration at any of the project stages may require revisions to the CSPP and review and approval by the airport operator and the FAA (see paragraph [1.4.2.17](#)).

2.5.3 FAA ATO Coordination.

Early coordination with FAA ATO is highly recommended during the design phase and is required for scheduling Technical Operations shutdowns prior to construction. Coordination is critical to restarts of NAVAID services and to the establishment of any special procedures for the movement of aircraft. Formal agreements between the airport operator and appropriate FAA offices are recommended. All relocation or adjustments to NAVAIDs, or changes to final grades in critical areas, should be coordinated with FAA ATO and may require an FAA flight inspection prior to restarting the facility. Flight inspections must be coordinated and scheduled well in advance of the intended facility restart. Flight inspections may require a reimbursable agreement between the airport operator and FAA ATO. Reimbursable agreements should be coordinated a minimum of 12 months prior to the start of construction. (See paragraph [2.13.5.3.2](#) for required FAA notification regarding FAA-owned NAVAIDs.)

2.6 **Phasing.**

Once it has been determined what types and levels of airport operations will be maintained, the most efficient sequence of construction may not be feasible. In this case, the sequence of construction may be phased to gain maximum efficiency while allowing for the required operations. The development of the resulting construction phases should be coordinated with local Air Traffic personnel and airport users. The sequenced construction phases established in the CSPP must be incorporated into the project design and must be reflected in the contract drawings and specifications.

2.6.1 Phase Elements.

For each phase the CSPP should detail:

- Areas closed to aircraft operations.
- Duration of closures.
- Taxi routes and/or areas of reduced TSA and TOFA to reflect reduced ADG use.
- ARFF access routes.
- Construction staging, disposal, and cleanout areas.
- Construction access and haul routes.
- Impacts to NAVAIDs.
- Lighting, marking, and signing changes.
- Available runway length and/or reduced RSA and ROFA to reflect reduced ADG use.
- Declared distances (if applicable).
- Required hazard marking, lighting, and signing.
- Work zone lighting for nighttime construction (if applicable).
- Lead times for required notifications.

2.6.2 Construction Safety Drawings.

Drawings specifically indicating operational safety procedures and methods in affected areas (i.e., construction safety drawings) should be developed for each construction phase. Such drawings should be included in the CSPP as referenced attachments and should also be included in the contract drawing package.

2.7 **Areas and Operations Affected by Construction Activity.**

Runways and taxiways should remain in use by aircraft to the maximum extent possible without compromising safety. Pre-meetings with the FAA ATO will support operational simulations. See Appendix E for an example of a table showing temporary operations versus current operations. The tables in Appendix E can be useful for coordination among all interested parties, including FAA Lines of Business.

2.7.1 Identification of Affected Areas.

Identifying areas and operations affected by the construction helps to determine possible safety problems. The affected areas should be identified in the construction safety drawings for each construction phase. (See paragraph 2.6.2.) Of particular concern are:

2.7.1.1 **Closing, or Partial Closing, of Runways, Taxiways and Aprons, and Displaced Thresholds.**

When a runway is partially closed, a portion of the pavement is unavailable for any aircraft operation, meaning taxiing, landing, or takeoff in either direction on that pavement is prohibited. A displaced threshold, by contrast, is established to ensure obstacle clearance and adequate safety area for landing aircraft. The pavement prior to the displaced threshold is normally available for take-off in the direction of the displacement and for landing and takeoff in the opposite direction. Misunderstanding this difference, may result in issuance of an inaccurate NOTAM, and can lead to a hazardous condition.

2.7.1.1.1 Partially Closed Runways.

The temporarily closed portion of a partially closed runway will generally extend from the threshold to a taxiway that may be used for entering and exiting the runway. If the closed portion extends to a point between taxiways, pilots will have to back-taxi on the runway, which is an undesirable operation. See Figure 2-1 for a desirable configuration.

2.7.1.1.2 Displaced Thresholds.

Since the portion of the runway pavement between the permanent threshold and a standard displaced threshold is available for takeoff and for landing in the opposite direction, the temporary displaced threshold need not be located at an entrance/exit taxiway. See Figure 2-2.

2.7.1.2 Closing of aircraft rescue and fire fighting access routes.

2.7.1.3 Closing of access routes used by airport and airline support vehicles.

2.7.1.4 Interruption of utilities, including water supplies for fire fighting.

2.7.1.5 Approach/departure surfaces affected by heights of objects.

2.7.1.6 Construction areas, storage areas, and access routes near runways, taxiways, aprons, or helipads.

Figure 2-1. Temporary Partially Closed Runway

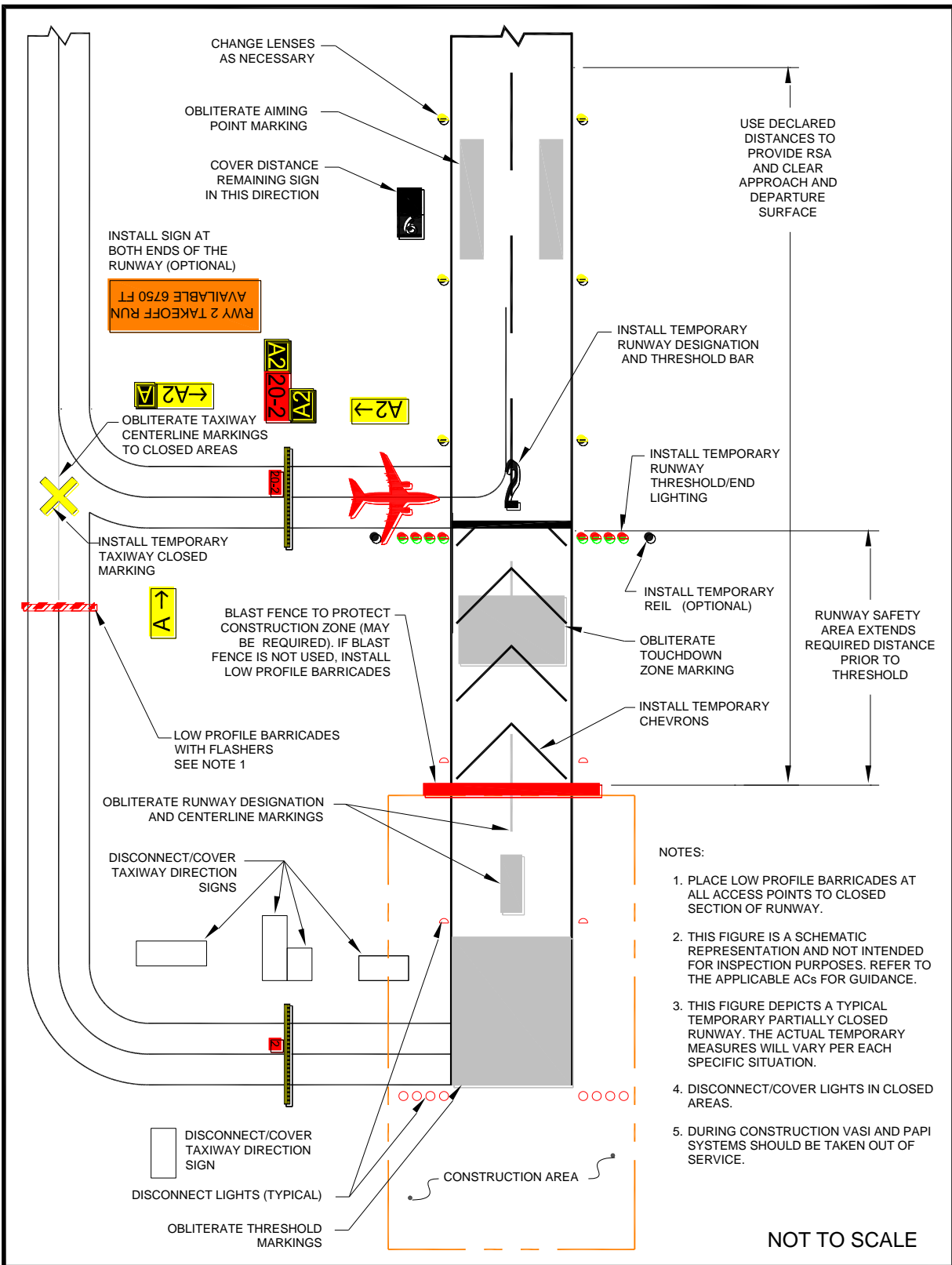
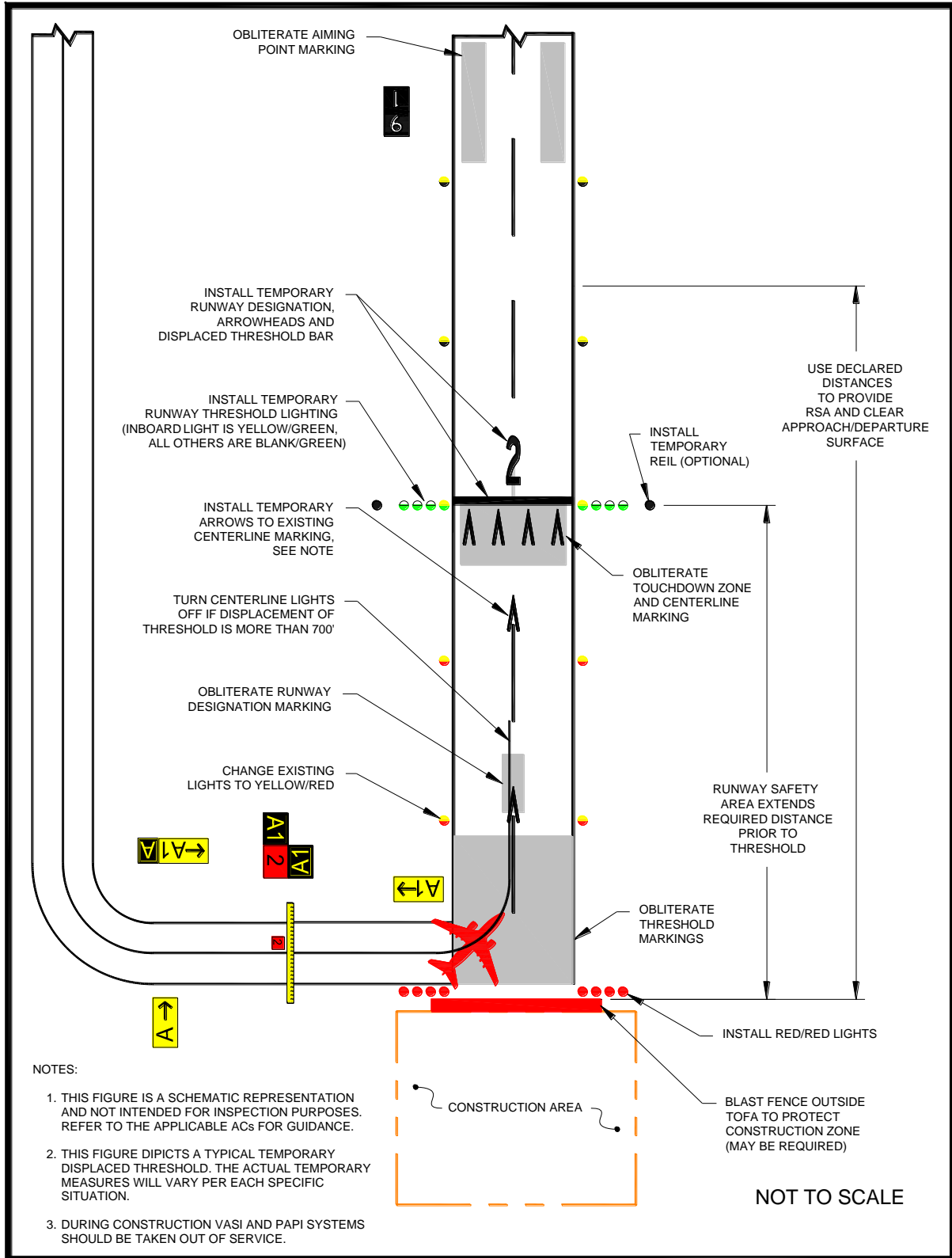


Figure 2-2. Temporary Displaced Threshold



Note: See paragraph 2.18.2.5.

2.7.2 Mitigation of Effects.

Establishment of specific procedures is necessary to maintain the safety and efficiency of airport operations. The CSPP must address:

- 2.7.2.1 Temporary changes to runway and/or taxi operations.
- 2.7.2.2 Detours for ARFF and other airport vehicles.
- 2.7.2.3 Maintenance of essential utilities.
- 2.7.2.4 Temporary changes to air traffic control procedures. Such changes must be coordinated with the ATO.

2.8 **Navigation Aid (NAVAID) Protection.**

Before commencing construction activity, parking vehicles, or storing construction equipment and materials near a NAVAID, coordinate with the appropriate FAA ATO/Technical Operations office to evaluate the effect of construction activity and the required distance and direction from the NAVAID. (See paragraph 2.13.5.3.) Construction activities, materials/equipment storage, and vehicle parking near electronic NAVAIDs require special consideration since they may interfere with signals essential to air navigation. If any NAVAID may be affected, the CSPP and SPCD must show an understanding of the “critical area” associated with each NAVAID and describe how it will be protected. Where applicable, the operational critical areas of NAVAIDs should be graphically delineated on the project drawings. Pay particular attention to stockpiling material, as well as to movement and parking of equipment that may interfere with line of sight from the ATCT or with electronic emissions. Interference from construction equipment and activities may require NAVAID shutdown or adjustment of instrument approach minimums for low visibility operations. This condition requires that a NOTAM be filed (see paragraph 2.13.2.) Construction activities and materials/equipment storage near a NAVAID must not obstruct access to the equipment and instruments for maintenance. Submittal of a 7460-1 form is required for construction vehicles operating near FAA NAVAIDs. (See paragraph 2.13.5.3.)

2.9 **Contractor Access.**

The CSPP must detail the areas to which the contractor must have access, and explain how contractor personnel will access those areas. Specifically address:

2.9.1 Location of Stockpiled Construction Materials.

Stockpiled materials and equipment storage are not permitted within the RSA and OFZ, and if possible should not be permitted within the Object Free Area (OFA) of an operational runway. Stockpiling material in the OFA requires submittal of a 7460-1 form and justification provided to the appropriate FAA Airports Regional or District Office for approval. The airport operator must ensure that stockpiled materials and equipment adjacent to these areas are prominently marked and lighted during hours of restricted visibility or darkness. (See paragraph 2.18.2.) This includes determining and

verifying that materials are stabilized and stored at an approved location so as not to be a hazard to aircraft operations and to prevent attraction of wildlife and foreign object damage from blowing or tracked material. See paragraphs 2.10 and 2.11.

2.9.2 Vehicle and Pedestrian Operations.

The CSPP should include specific vehicle and pedestrian requirements. Vehicle and pedestrian access routes for airport construction projects must be controlled to prevent inadvertent or unauthorized entry of persons, vehicles, or animals onto the AOA. The airport operator should coordinate requirements for vehicle operations with airport tenants, contractors, and the FAA air traffic manager. In regard to vehicle and pedestrian operations, the CSPP should include the following, with associated training requirements:

2.9.2.1 **Construction Site Parking.**

Designate in advance vehicle parking areas for contractor employees to prevent any unauthorized entry of persons or vehicles onto the AOA. These areas should provide reasonable contractor employee access to the job site.

2.9.2.2 **Construction Equipment Parking.**

Contractor employees must park and service all construction vehicles in an area designated by the airport operator outside the OFZ and never in the safety area of an active runway or taxiway. Unless a complex setup procedure makes movement of specialized equipment infeasible, inactive equipment must not be parked on a closed taxiway or runway. If it is necessary to leave specialized equipment on a closed taxiway or runway at night, the equipment must be well lighted. Employees should also park construction vehicles outside the OFA when not in use by construction personnel (for example, overnight, on weekends, or during other periods when construction is not active). Parking areas must not obstruct the clear line of sight by the ATCT to any taxiways or runways under air traffic control nor obstruct any runway visual aids, signs, or navigation aids. The FAA must also study those areas to determine effects on airport design criteria, surfaces established by 14 CFR Part 77, Safe, Efficient Use, and Preservation of the Navigable Airspace (Part 77), and on NAVAIDs and Instrument Approach Procedures (IAP). See paragraph 2.13.1 for further information.

2.9.2.3 **Access and Haul Roads.**

Determine the construction contractor's access to the construction sites and haul roads. Do not permit the construction contractor to use any access or haul roads other than those approved. Access routes used by contractor vehicles must be clearly marked to prevent inadvertent entry to areas open to airport operations. Pay special attention to ensure that if construction traffic is to share or cross any ARFF routes that ARFF right of way is not impeded at any time, and that construction traffic on haul

roads does not interfere with NAVAIDs or approach surfaces of operational runways. Address whether access gates will be blocked or inoperative or if a rally point will be blocked or inaccessible.

- 2.9.2.4 Marking and lighting of vehicles in accordance with AC 150/5210-5, *Painting, Marking, and Lighting of Vehicles Used on an Airport*.
- 2.9.2.5 Description of proper vehicle operations on various areas under normal, lost communications, and emergency conditions.
- 2.9.2.6 Required escorts.
- 2.9.2.7 **Training Requirements for Vehicle Drivers to Ensure Compliance with the Airport Operator's Vehicle Rules and Regulations.**
Specific training should be provided to vehicle operators, including those providing escorts. See AC 150/5210-20, *Ground Vehicle Operations on Airports*, for information on training and records maintenance requirements.
- 2.9.2.8 **Situational Awareness.**
Vehicle drivers must confirm by personal observation that no aircraft is approaching their position (either in the air or on the ground) when given clearance to cross a runway, taxiway, or any other area open to airport operations. In addition, it is the responsibility of the escort vehicle driver to verify the movement/position of all escorted vehicles at any given time. At non-towered airports, all aircraft movements and flight operations rely on aircraft operators to self-report their positions and intentions. However, there is no requirement for an aircraft to have radio communications. Because aircraft do not always broadcast their positions or intentions, visual checking, radio monitoring, and situational awareness of the surroundings is critical to safety.
- 2.9.2.9 **Two-Way Radio Communication Procedures.**
- 2.9.2.9.1 General.
The airport operator must ensure that tenant and construction contractor personnel engaged in activities involving unescorted operation on aircraft movement areas observe the proper procedures for communications, including using appropriate radio frequencies at airports with and without ATCT. When operating vehicles on or near open runways or taxiways, construction personnel must understand the critical importance of maintaining radio contact, as directed by the airport operator, with:
1. Airport operations
 2. ATCT

3. Common Traffic Advisory Frequency (CTAF), which may include UNICOM, MULTICOM.
4. Automatic Terminal Information Service (ATIS). This frequency is useful for monitoring conditions on the airport. Local air traffic will broadcast information regarding construction related runway closures and “shortened” runways on the ATIS frequency.

2.9.2.9.2 Areas Requiring Two-Way Radio Communication with the ATCT.

Vehicular traffic crossing active movement areas must be controlled either by two-way radio with the ATCT, escort, flagman, signal light, or other means appropriate for the particular airport.

2.9.2.9.3 Frequencies to be Used.

The airport operator will specify the frequencies to be used by the contractor, which may include the CTAF for monitoring of aircraft operations. Frequencies may also be assigned by the airport operator for other communications, including any radio frequency in compliance with Federal Communications Commission requirements. At airports with an ATCT, the airport operator will specify the frequency assigned by the ATCT to be used between contractor vehicles and the ATCT.

2.9.2.9.4 Proper radio usage, including read back requirements.

2.9.2.9.5 Proper phraseology, including the International Phonetic Alphabet.

2.9.2.9.6 Light Gun Signals.

Even though radio communication is maintained, escort vehicle drivers must also familiarize themselves with ATCT light gun signals in the event of radio failure. See the FAA safety placard “Ground Vehicle Guide to Airport Signs and Markings.” This safety placard may be downloaded through the Runway Safety Program Web site at http://www.faa.gov/airports/runway_safety/publications/ (see “Signs & Markings Vehicle Dashboard Sticker”) or obtained from the FAA Airports Regional Office.

2.9.2.10 **Maintenance of the secured area of the airport, including:**

2.9.2.10.1 Fencing and Gates.

Airport operators and contractors must take care to maintain security during construction when access points are created in the security fencing to permit the passage of construction vehicles or personnel. Temporary gates should be equipped so they can be securely closed and locked to prevent access by animals and unauthorized people. Procedures should be in place to ensure that only authorized persons and vehicles have access to the AOA and to prohibit “piggybacking” behind another person or vehicle. The Department of Transportation (DOT) document DOT/FAA/AR-

00/52, *Recommended Security Guidelines for Airport Planning and Construction*, provides more specific information on fencing. A copy of this document can be obtained from the Airport Consultants Council, Airports Council International, or American Association of Airport Executives.

2.9.2.10.2 Badging Requirements.

Airports subject to 49 CFR Part 1542, *Airport Security*, must meet standards for access control, movement of ground vehicles, and identification of construction contractor and tenant personnel.

2.10 **Wildlife Management.**

The CSPP and SPCD must be in accordance with the airport operator's wildlife hazard management plan, if applicable. See AC 150/5200-33, *Hazardous Wildlife Attractants On or Near Airports*, and CertAlert 98-05, *Grasses Attractive to Hazardous Wildlife*. Construction contractors must carefully control and continuously remove waste or loose materials that might attract wildlife. Contractor personnel must be aware of and avoid construction activities that can create wildlife hazards on airports, such as:

2.10.1 Trash.

Food scraps must be collected from construction personnel activity.

2.10.2 Standing Water.

2.10.3 Tall Grass and Seeds.

Requirements for turf establishment can be at odds with requirements for wildlife control. Grass seed is attractive to birds. Lower quality seed mixtures can contain seeds of plants (such as clover) that attract larger wildlife. Seeding should comply with the guidance in AC 150/5370-10, *Standards for Specifying Construction of Airports*, Item T-901, Seeding. Contact the local office of the United States Department of Agriculture Soil Conservation Service or the State University Agricultural Extension Service (County Agent or equivalent) for assistance and recommendations. These agencies can also provide liming and fertilizer recommendations.

2.10.4 Poorly Maintained Fencing and Gates.

See paragraph 2.9.2.10.1.

2.10.5 Disruption of Existing Wildlife Habitat.

While this will frequently be unavoidable due to the nature of the project, the CSPP should specify under what circumstances (location, wildlife type) contractor personnel should immediately notify the airport operator of wildlife sightings.

2.11 Foreign Object Debris (FOD) Management.

Waste and loose materials, commonly referred to as FOD, are capable of causing damage to aircraft landing gears, propellers, and jet engines. Construction contractors must not leave or place FOD on or near active aircraft movement areas. Materials capable of creating FOD must be continuously removed during the construction project. Fencing (other than security fencing) or covers may be necessary to contain material that can be carried by wind into areas where aircraft operate. See AC 150/5210-24, *Foreign Object Debris (FOD) Management*.

2.12 Hazardous Materials (HAZMAT) Management.

Contractors operating construction vehicles and equipment on the airport must be prepared to expeditiously contain and clean-up spills resulting from fuel or hydraulic fluid leaks. Transport and handling of other hazardous materials on an airport also requires special procedures. See AC 150/5320-15, *Management of Airport Industrial Waste*.

2.13 Notification of Construction Activities.

The CSPP and SPCD must detail procedures for the immediate notification of airport users and the FAA of any conditions adversely affecting the operational safety of the airport. It must address the notification actions described below, as applicable.

2.13.1 List of Responsible Representatives/points of contact for all involved parties, and procedures for contacting each of them, including after hours.

2.13.2 NOTAMs.

Only the airport operator may initiate or cancel NOTAMs on airport conditions, and is the only entity that can close or open a runway. The airport operator must coordinate the issuance, maintenance, and cancellation of NOTAMs about airport conditions resulting from construction activities with tenants and the local air traffic facility (control tower, approach control, or air traffic control center), and must either enter the NOTAM into NOTAM Manager, or provide information on closed or hazardous conditions on airport movement areas to the FAA Flight Service Station (FSS) so it can issue a NOTAM. The airport operator must file and maintain a list of authorized representatives with the FSS. Refer to AC 150/5200-28, *Notices to Airmen (NOTAMs) for Airport Operators*, for a sample NOTAM form. Only the FAA may issue or cancel NOTAMs on shutdown or irregular operation of FAA owned facilities. Any person having reason to believe that a NOTAM is missing, incomplete, or inaccurate must notify the airport operator. See paragraph 2.7.1.1 about issuing NOTAMs for partially closed runways versus runways with displaced thresholds.

2.13.3 Emergency notification procedures for medical, fire fighting, and police response.

2.13.4 Coordination with ARFF.

The CSPP must detail procedures for coordinating through the airport sponsor with ARFF personnel, mutual aid providers, and other emergency services if construction requires:

1. The deactivation and subsequent reactivation of water lines or fire hydrants, or
2. The rerouting, blocking and restoration of emergency access routes, or
3. The use of hazardous materials on the airfield.

2.13.5 Notification to the FAA.

2.13.5.1 **Part 77.**

Any person proposing construction or alteration of objects that affect navigable airspace, as defined in Part 77, must notify the FAA. This includes construction equipment and proposed parking areas for this equipment (i.e., cranes, graders, other equipment) on airports. FAA Form 7460-1, *Notice of Proposed Construction or Alteration*, can be used for this purpose and submitted to the appropriate FAA Airports Regional or District Office. See Appendix A to download the form. Further guidance is available on the FAA web site at oeaaa.faa.gov.

2.13.5.2 **Part 157.**

With some exceptions, Title 14 CFR Part 157, *Notice of Construction, Alteration, Activation, and Deactivation of Airports*, requires that the airport operator notify the FAA in writing whenever a non-Federally funded project involves the construction of a new airport; the construction, realigning, altering, activating, or abandoning of a runway, landing strip, or associated taxiway; or the deactivation or abandoning of an entire airport. Notification involves submitting FAA Form 7480-1, *Notice of Landing Area Proposal*, to the nearest FAA Airports Regional or District Office. See Appendix A to download the form.

2.13.5.3 **NAVAIDs.**

For emergency (short-notice) notification about impacts to both airport owned and FAA owned NAVAIDs, contact: 866-432-2622.

2.13.5.3.1 Airport Owned/FAA Maintained.

If construction operations require a shutdown of 24 hours or greater in duration, or more than 4 hours daily on consecutive days, of a NAVAID owned by the airport but maintained by the FAA, provide a 45-day minimum notice to FAA ATO/Technical Operations prior to facility shutdown, using Strategic Event Coordination (SEC) Form 6000.26 contained within FAA Order 6000.15, *General Maintenance Handbook for National Airspace System (NAS) Facilities*.

2.13.5.3.2 FAA Owned.

1. The airport operator must notify the appropriate FAA ATO Service Area Planning and Requirements (P&R) Group a minimum of 45 days prior to implementing an event that causes impacts to NAVAIDs, using SEC Form 6000.26.
2. Coordinate work for an FAA owned NAVAID shutdown with the local FAA ATO/Technical Operations office, including any necessary reimbursable agreements and flight checks. Detail procedures that address unanticipated utility outages and cable cuts that could impact FAA NAVAIDs. Refer to active Service Level Agreement with ATO for specifics.

2.14 **Inspection Requirements.**

2.14.1 Daily Inspections.

Inspections should be conducted at least daily, but more frequently if necessary to ensure conformance with the CSPP. A sample checklist is provided in Appendix D, Construction Project Daily Safety Inspection Checklist. See also AC 150/5200-18, Airport Safety Self-Inspection. Airport operators holding a Part 139 certificate are required to conduct self-inspections during unusual conditions, such as construction activities, that may affect safe air carrier operations.

2.14.2 Interim Inspections.

Inspections should be conducted of all areas to be (re)opened to aircraft traffic to ensure the proper operation of lights and signs, for correct markings, and absence of FOD. The contractor should conduct an inspection of the work area with airport operations personnel. The contractor should ensure that all construction materials have been secured, all pavement surfaces have been swept clean, all transition ramps have been properly constructed, and that surfaces have been appropriately marked for aircraft to operate safely. Only if all items on the list meet with the airport operator's approval should the air traffic control tower be notified to open the area to aircraft operations. The contractor should be required to retain a suitable workforce and the necessary equipment at the work area for any last minute cleanup that may be requested by the airport operator prior to opening the area.

2.14.3 Final Inspections.

New runways and extended runway closures may require safety inspections at certificated airports prior to allowing air carrier service. Coordinate with the FAA Airport Certification Safety Inspector (ACSI) to determine if a final inspection will be necessary.

2.15 Underground Utilities.

The CSPP and/or SPCD must include procedures for locating and protecting existing underground utilities, cables, wires, pipelines, and other underground facilities in excavation areas. This may involve coordinating with public utilities and FAA ATO/Technical Operations. Note that “One Call” or “Miss Utility” services do not include FAA ATO/Technical Operations.

2.16 Penalties.

The CSPP should detail penalty provisions for noncompliance with airport rules and regulations and the safety plans (for example, if a vehicle is involved in a runway incursion). Such penalties typically include rescission of driving privileges or access to the AOA.

2.17 Special Conditions.

The CSPP must detail any special conditions that affect the operation of the airport and will require the activation of any special procedures (for example, low-visibility operations, snow removal, aircraft in distress, aircraft accident, security breach, Vehicle / Pedestrian Deviation (VPD) and other activities requiring construction suspension/resumption).

2.18 Runway and Taxiway Visual Aids.

This includes marking, lighting, signs, and visual NAVAIDs. The CSPP must ensure that areas where aircraft will be operating are clearly and visibly separated from construction areas, including closed runways. Throughout the duration of the construction project, verify that these areas remain clearly marked and visible at all times and that marking, lighting, signs, and visual NAVAIDs that are to continue to perform their functions during construction remain in place and operational. Visual NAVAIDs that are not serving their intended function during construction must be temporarily disabled, covered, or modified as necessary. The CSPP must address the following, as appropriate:

2.18.1 General.

Airport markings, lighting, signs, and visual NAVAIDs must be clearly visible to pilots, not misleading, confusing, or deceptive. All must be secured in place to prevent movement by prop wash, jet blast, wing vortices, and other wind currents and constructed of materials that will minimize damage to an aircraft in the event of inadvertent contact. Items used to secure such markings must be of a color similar to the marking.

2.18.2 Markings.

During the course of construction projects, temporary pavement markings are often required to allow for aircraft operations during or between work periods. During the design phase of the project, the designer should coordinate with the project manager,

airport operations, airport users, the FAA Airports project manager, and Airport Certification Safety Inspector for Part 139 airports to determine minimum temporary markings. The FAA Airports project manager will, wherever a runway is closed, coordinate with the appropriate FAA Flight Standards Office and disseminate findings to all parties. Where possible, the temporary markings on finish grade pavements should be placed to mirror the dimensions of the final markings. Markings must be in compliance with the standards of AC 150/5340-1, *Standards for Airport Markings*, except as noted herein. Runways and runway exit taxiways closed to aircraft operations are marked with a yellow X. The preferred visual aid to depict temporary runway closure is the lighted X signal placed on or near the runway designation numbers. (See paragraph 2.18.2.1.2.)

2.18.2.1 **Closed Runways and Taxiways.**

2.18.2.1.1 Permanently Closed Runways.

For runways, obliterate the threshold marking, runway designation marking, and touchdown zone markings, and place an X at each end and at 1,000-foot (300 m) intervals. For a multiple runway environment, if the lighted X on a designated number will be located in the RSA of an adjacent active runway, locate the lighted X farther down the closed runway to clear the RSA of the active runway. In addition, the closed runway numbers located in the RSA of an active runway must be marked with a flat yellow X.

2.18.2.1.2 Temporarily Closed Runways.

For runways that have been temporarily closed, place an X at each end of the runway directly on or as near as practicable to the runway designation numbers. For a multiple runway environment, if the lighted X on a designated number will be located in the RSA of an adjacent active runway, locate the lighted X farther down the closed runway to clear the RSA of the active runway. In addition, the closed runway numbers located in the RSA of an active runway must be marked with a flat yellow X. See Figure 2-3. See also paragraph 2.18.3.3.

2.18.2.1.3 Partially Closed Runways and Displaced Thresholds.

When threshold markings are needed to identify the temporary beginning of the runway that is available for landing, the markings must comply with AC 150/5340-1. An X is not used on a partially closed runway or a runway with a displaced threshold. See paragraph 2.7.1.1 for the difference between partially closed runways and runways with displaced thresholds. Because of the temporary nature of threshold displacement due to construction, it is not necessary to re-adjust the existing runway centerline markings to meet standard spacing for a runway with a visual approach. Some of the requirements below may be waived in the cases of low-activity airports and/or short duration changes that are measured in days rather than weeks. Consider whether the presence of an airport traffic

control tower allows for the development of special procedures. Contact the appropriate FAA Airports Regional or District Office for assistance.

Figure 2-3. Markings for a Temporarily Closed Runway

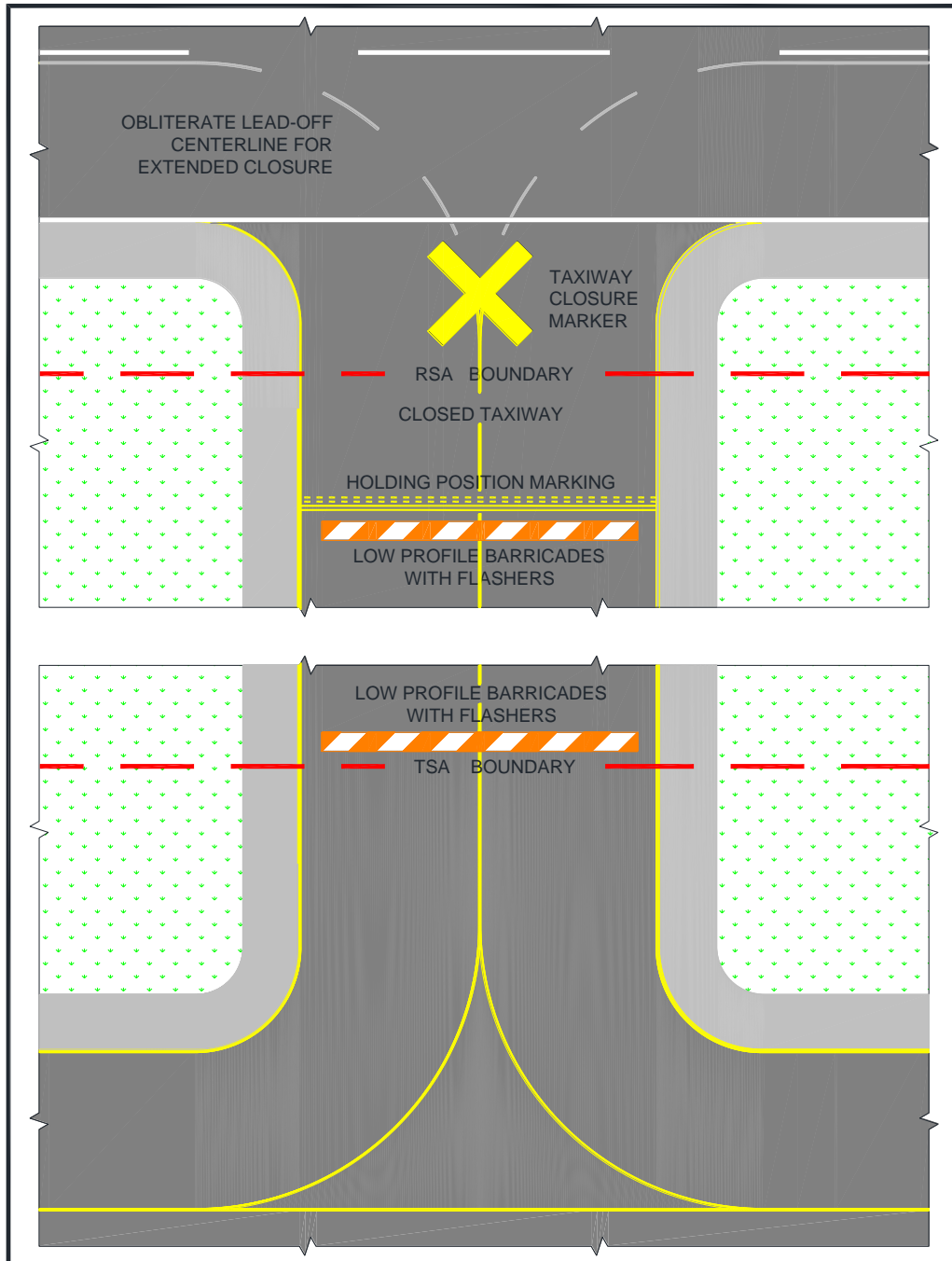


1. **Partially Closed Runways.** Pavement markings for temporary closed portions of the runway consist of a runway threshold bar, runway designation, and yellow chevrons to identify pavement areas that are unsuitable for takeoff or landing (see [AC 150/5340-1](#)). Obliterate or cover markings prior to the moved threshold. Existing touchdown zone markings beyond the moved threshold may remain in place. Obliterate aiming point markings. Issue appropriate NOTAMs regarding any nonstandard markings. See [Figure 2-4](#).
2. **Displaced Thresholds.** Pavement markings for a displaced threshold consist of a runway threshold bar, runway designation, and white arrowheads with and without arrow shafts. These markings are required to identify the portion of the runway before the displaced threshold to provide centerline guidance for pilots during approaches, takeoffs, and landing rollouts from the opposite direction. See [AC 150/5340-1](#). Obliterate markings prior to the displaced threshold. Existing touchdown zone markings beyond the displaced threshold may remain in place. Obliterate aiming point markings. Issue appropriate NOTAMs regarding any nonstandard markings. See [Figure 2-2](#).

2.18.2.1.4 Taxiways.

1. **Permanently Closed Taxiways.** *AC 150/5300-13 Airport Design*, notes that it is preferable to remove the pavement, but for pavement that is to remain, place an X at the entrance to both ends of the closed section. Obliterate taxiway centerline markings, including runway leadoff lines, leading to the closed taxiway. See [Figure 2-4](#).

Figure 2-4. Temporary Taxiway Closure



2. **Temporarily Closed Taxiways.** Place barricades outside the safety area of intersecting taxiways. For runway/taxiway intersections, place an X at the entrance to the closed taxiway from the runway. If the taxiway will be closed for an extended period, obliterate taxiway centerline markings, including runway leadoff lines and taxiway to taxiway turns, leading to the closed section. Always obliterate runway lead-off lines for high speed exits, regardless of the duration of the closure. If the centerline markings will be reused upon reopening the taxiway, it is preferable to paint over the marking. This will result in less damage to the pavement when the upper layer of paint is ultimately removed. See Figure 2-4.

2.18.2.1.5 Temporarily Closed Airport.

When the airport is closed temporarily, mark all the runways as closed.

- 2.18.2.2 If unable to paint temporary markings on the pavement, construct them from any of the following materials: fabric, colored plastic, painted sheets of plywood, or similar materials. They must be properly configured and appropriately secured to prevent movement by prop wash, jet blast, or other wind currents. Items used to secure such markings must be of a color similar to the marking.

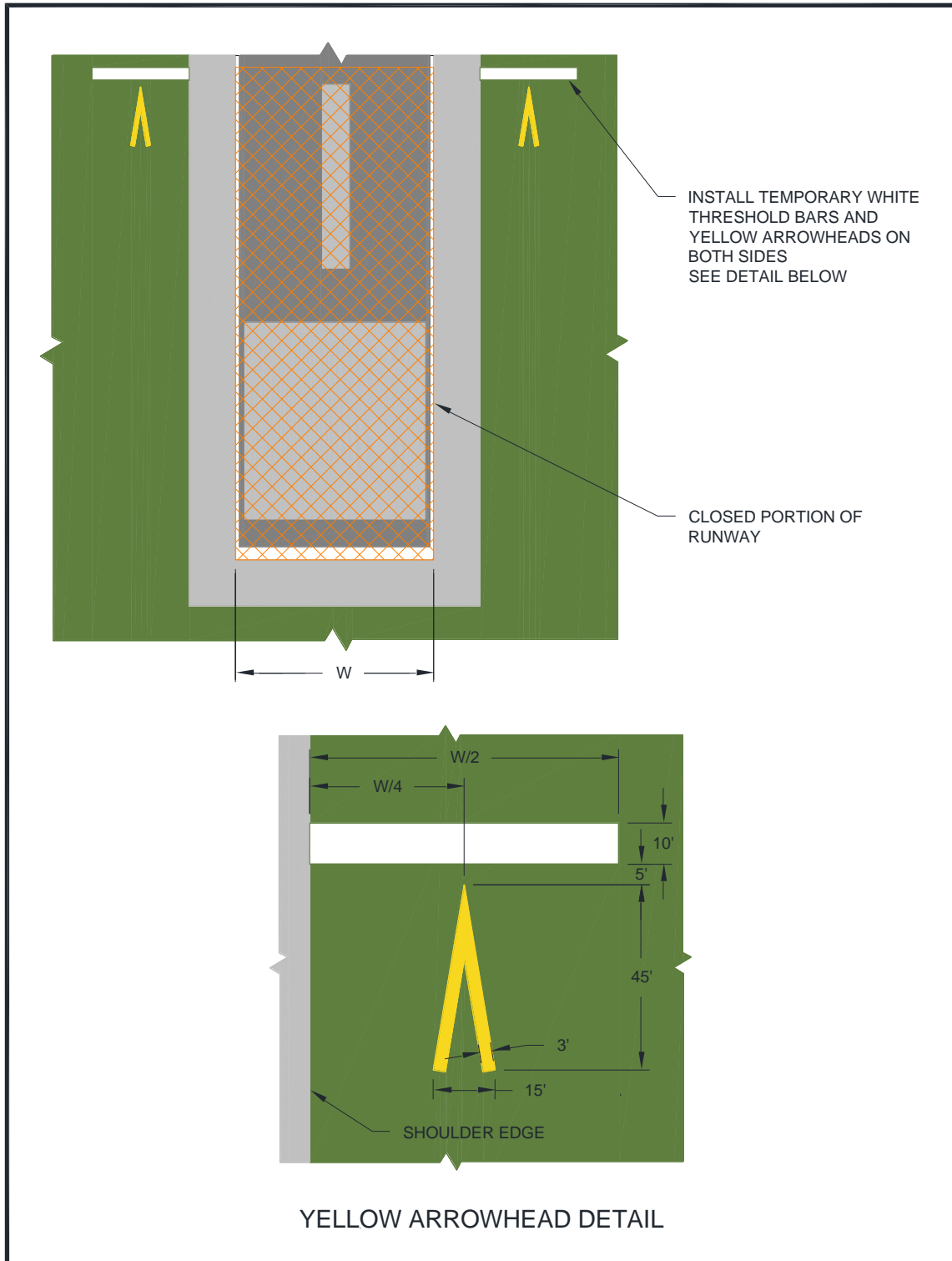
- 2.18.2.3 It may be necessary to remove or cover runway markings, including but not limited to, runway designation markings, threshold markings, centerline markings, edge stripes, touchdown zone markings and aiming point markings, depending on the length of construction and type of activity at the airport. When removing runway markings, apply the same treatment to areas between stripes or numbers, as the cleaned area will appear to pilots as a marking in the shape of the treated area.

- 2.18.2.4 If it is not possible to install threshold bars, chevrons, and arrows on the pavement, “temporary outboard white threshold bars and yellow arrowheads”, see Figure 2-5, may be used. Locate them outside of the runway pavement surface on both sides of the runway. The dimensions must be as shown in Figure 2-5. If the markings are not discernible on grass or snow, apply a black background with appropriate material over the ground to ensure they are clearly visible.

- 2.18.2.5 The application rate of paint to mark a short-term temporary runway and taxiway markings may deviate from the standard (see Item P-620, “Runway and Taxiway Painting,” in AC 150/5370-10), but the dimensions must meet the existing standards. When applying temporary markings at night, it is recommended that the fast curing, Type II paint be used to help offset the higher humidity and cooler temperatures often experienced at night. Diluting the paint will substantially increase cure time and is not recommended. Glass beads are not recommended for temporary markings. Striated markings may also be used for certain temporary markings. AC

150/5340-1, *Standards for Airport Markings*, has additional guidance on temporary markings.

Figure 2-5. Temporary Outboard White Threshold Bars and Yellow Arrowheads



2.18.3 Lighting and Visual NAVAIDs.

This paragraph refers to standard runway and taxiway lighting systems. See below for hazard lighting. Lighting installation must be in conformance with AC 150/5340-30, *Design and Installation Details for Airport Visual Aids*, and fixture design in conformance with AC 150/5345-50, *Specification for Portable Runway and Taxiway Lights*. When disconnecting runway and taxiway lighting fixtures, disconnect the associated isolation transformers. See AC 150/5340-26, *Maintenance of Airport Visual Aid Facilities*, for disconnect procedures and safety precautions. Alternately, cover the light fixture in such a way as to prevent light leakage. Avoid removing the lamp from energized fixtures because an excessive number of isolation transformers with open secondaries may damage the regulators and/or increase the current above its normal value. Secure, identify, and place any above ground temporary wiring in conduit to prevent electrocution and fire ignition sources. Maintain mandatory hold signs to operate normally in any situation where pilots or vehicle drivers could mistakenly be in that location. At towered airports certificated under Part 139, holding position signs are required to be illuminated on open taxiways crossing to closed or inactive runways. If the holding position sign is installed on the runway circuit for the closed runway, install a jumper to the taxiway circuit to provide power to the holding position sign for nighttime operations. Where it is not possible to maintain power to signs that would normally be operational, install barricades to exclude aircraft. Figure 2-1, Figure 2-2, Figure 2-3, and Figure 2-4 illustrate temporary changes to lighting and visual NAVAIDs.

2.18.3.1 **Permanently Closed Runways and Taxiways.**

For runways and taxiways that have been permanently closed, disconnect the lighting circuits.

2.18.3.2 **Temporarily Closed Runways and New Runways Not Yet Open to Air Traffic.**

If available, use a lighted X, both at night and during the day, placed at each end of the runway on or near the runway designation numbers facing the approach. (Note that the lighted X must be illuminated at all times that it is on a runway.) The use of a lighted X is required if night work requires runway lighting to be on. See AC 150/5345-55, *Specification for L-893, Lighted Visual Aid to Indicate Temporary Runway Closure*. For runways that have been temporarily closed, but for an extended period, and for those with pilot controlled lighting, disconnect the lighting circuits or secure switches to prevent inadvertent activation. For runways that will be opened periodically, coordinate procedures with the FAA air traffic manager or, at airports without an ATCT, the airport operator. Activate stop bars if available. Figure 2-6 shows a lighted X by day. Figure 2-7 shows a lighted X at night.

Figure 2-6. Lighted X in Daytime**Figure 2-7. Lighted X at Night****2.18.3.3 Partially Closed Runways and Displaced Thresholds.**

When a runway is partially closed, a portion of the pavement is unavailable for any aircraft operation, meaning taxiing and landing or taking off in either direction. A displaced threshold, by contrast, is put in place to ensure obstacle clearance by landing aircraft. The pavement prior to the displaced threshold is available for takeoff in the direction of the displacement, and for landing and takeoff in the opposite direction. Misunderstanding this difference and issuance of a subsequently inaccurate NOTAM can result in a hazardous situation. For both partially

closed runways and displaced thresholds, approach lighting systems at the affected end must be placed out of service.

2.18.3.3.1 Partially Closed Runways.

Disconnect edge and threshold lights on that part of the runway at and behind the threshold (that is, the portion of the runway that is closed). Alternately, cover the light fixtures in such a way as to prevent light leakage. See Figure 2-1.

2.18.3.3.2 Temporary Displaced Thresholds.

Edge lighting in the area of the displacement emits red light in the direction of approach and yellow light (white for visual runways) in the opposite direction. If the displacement is 700 feet or less, blank out centerline lights in the direction of approach or place the centerline lights out of service. If the displacement is over 700 feet, place the centerline lights out of service. See AC 150/5340-30 for details on lighting displaced thresholds. See Figure 2-2.

2.18.3.3.3 Temporary runway thresholds and runway ends must be lighted if the runway is lighted and it is the intended threshold for night landings or instrument meteorological conditions.

2.18.3.3.4 A temporary threshold on an unlighted runway may be marked by retroreflective, elevated markers in addition to markings noted in paragraph 2.18.2.1.3. Markers seen by aircraft on approach are green. Markers at the rollout end of the runway are red. At certificated airports, temporary elevated threshold markers must be mounted with a frangible fitting (see 14 CFR Part 139.309). At non-certificated airports, the temporary elevated threshold markings may either be mounted with a frangible fitting or be flexible. See AC 150/5345-39, *Specification for L-853, Runway and Taxiway Retroreflective Markers*.

2.18.3.3.5 Temporary threshold lights and runway end lights and related visual NAVAIDs are installed outboard of the edges of the full-strength pavement only when they cannot be installed on the pavement. They are installed with bases at grade level or as low as possible, but not more than 3 inch (7.6 cm) above ground. (The standard above ground height for airport lighting fixtures is 14 inches (35 cm)). When any portion of a base is above grade, place properly compacted fill around the base to minimize the rate of gradient change so aircraft can, in an emergency, cross at normal landing or takeoff speeds without incurring significant damage. See AC 150/5370-10.

2.18.3.3.6 Maintain threshold and edge lighting color and spacing standards as described in AC 150/5340-30. Battery powered, solar, or portable lights that meet the criteria in AC 150/5345-50 may be used. These systems are intended primarily for visual flight rules (VFR) aircraft operations but may

be used for instrument flight rules (IFR) aircraft operations, upon individual approval from the Flight Standards Division of the applicable FAA Regional Office.

- 2.18.3.3.7 When runway thresholds are temporarily displaced, reconfigure yellow lenses (caution zone), as necessary, and place the centerline lights out of service.
- 2.18.3.3.8 Relocate the Visual Glide Slope Indicator (VGSI), such as Visual Approach Slope Indicator (VASI) and Precision Approach Path Indicator (PAPI); other airport lights, such as Runway End Identifier Lights (REIL); and approach lights to identify the temporary threshold. Another option is to disable the VGSI or any equipment that would give misleading indications to pilots as to the new threshold location. Installation of temporary visual aids may be necessary to provide adequate guidance to pilots on approach to the affected runway. If the FAA owns and operates the VGSI, coordinate its installation or disabling with the local ATO/Technical Operations Office. Relocation of such visual aids will depend on the duration of the project and the benefits gained from the relocation, as this can result in great expense. See FAA JO 6850.2, *Visual Guidance Lighting Systems*, for installation criteria for FAA owned and operated NAVAIDs.
- 2.18.3.3.9 Issue a NOTAM to inform pilots of temporary lighting conditions.

2.18.3.4 **Temporarily Closed Taxiways.**

If possible, deactivate the taxiway lighting circuits. When deactivation is not possible (for example other taxiways on the same circuit are to remain open), cover the light fixture in a way as to prevent light leakage.

2.18.4 Signs.

To the extent possible, signs must be in conformance with AC 150/5345-44, *Specification for Runway and Taxiway Signs*, and AC 150/5340-18, *Standard for Airport Sign Systems*.

2.18.4.1 **Existing Signs.**

Runway exit signs are to be covered for closed runway exits. Outbound destination signs are to be covered for closed runways. Any time a sign does not serve its normal function or would provide conflicting information, it must be covered or removed to prevent misdirecting pilots. Note that information signs identifying a crossing taxiway continue to perform their normal function even if the crossing taxiway is closed. For long term construction projects, consider relocating signs, especially runway distance remaining signs.

2.18.4.2 **Temporary Signs.**

Orange construction signs comprise a message in black on an orange background. Orange construction signs may help pilots be aware of changed conditions. The airport operator may choose to introduce these signs as part of a movement area construction project to increase situational awareness when needed. Locate signs outside the taxiway safety limits and ahead of construction areas so pilots can take timely action. Use temporary signs judiciously, striking a balance between the need for information and the increase in pilot workload. When there is a concern of pilot “information overload,” the applicability of mandatory hold signs must take precedence over orange construction signs recommended during construction. Temporary signs must meet the standards for such signs in Engineering Brief 93, *Guidance for the Assembly and Installation of Temporary Orange Construction Signs*. Many criteria in AC 150/5345-44, *Specification for Runway and Taxiway Signs*, are referenced in the Engineering Brief. Permissible sign legends are:

1. CONSTRUCTION AHEAD,
2. CONSTRUCTION ON RAMP, and
3. RWY XX TAKEOFF RUN AVAILABLE XXX FT.

Phasing, supported by drawings and sign schedule, for the installation of orange construction signs must be included in the CSPP or SPCD.

2.18.4.2.1 Takeoff Run Available (TORA) signs.

Recommended: Where a runway has been shortened for takeoff, install orange TORA signs well before the hold lines, such as on a parallel taxiway prior to a turn to a runway hold position. See EB 93 for sign size and location.

2.18.4.2.2 Sign legends are shown in Figure F-1.

Note: See Figure E-1, Figure E-2, Figure E-3, Figure F-2, and Figure F-3 for examples of orange construction sign locations.

2.19 **Marking and Signs for Access Routes.**

The CSPP should indicate that pavement markings and signs for construction personnel will conform to AC 150/5340-18 and, to the extent practicable, with the Federal Highway Administration Manual on Uniform Traffic Control Devices (MUTCD) and/or State highway specifications. Signs adjacent to areas used by aircraft must comply with the frangibility requirements of AC 150/5220-23, *Frangible Connections*, which may require modification to size and height guidance in the MUTCD.

2.20 **Hazard Marking, Lighting and Signing.**

2.20.1 Hazard marking, lighting, and signing prevent pilots from entering areas closed to aircraft, and prevent construction personnel from entering areas open to aircraft. The CSPP must specify prominent, comprehensible warning indicators for any area affected by construction that is normally accessible to aircraft, personnel, or vehicles. Hazard marking and lighting must also be specified to identify open manholes, small areas under repair, stockpiled material, waste areas, and areas subject to jet blast. Also consider less obvious construction-related hazards and include markings to identify FAA, airport, and National Weather Service facilities cables and power lines; instrument landing system (ILS) critical areas; airport surfaces, such as RSA, OFA, and OFZ; and other sensitive areas to make it easier for contractor personnel to avoid these areas.

2.20.2 Equipment.

2.20.2.1 **Barricades.**

Low profile barricades, including traffic cones, (weighted or sturdily attached to the surface) are acceptable methods used to identify and define the limits of construction and hazardous areas on airports. Careful consideration must be given to selecting equipment that poses the least danger to aircraft but is sturdy enough to remain in place when subjected to typical winds, prop wash and jet blast. The spacing of barricades must be such that a breach is physically prevented barring a deliberate act. For example, if barricades are intended to exclude aircraft, gaps between barricades must be smaller than the wingspan of the smallest aircraft to be excluded; if barricades are intended to exclude vehicles, gaps between barricades must be smaller than the width of the excluded vehicles, generally 4 feet (1.2 meters). Provision must be made for ARFF access if necessary. If barricades are intended to exclude pedestrians, they must be continuously linked. Continuous linking may be accomplished through the use of ropes, securely attached to prevent FOD.

2.20.2.2 **Lights.**

Lights must be red, either steady burning or flashing, and must meet the luminance requirements of the State Highway Department. Batteries powering lights will last longer if lights flash. Lights must be mounted on barricades and spaced at no more than 10 feet (3 meters). Lights must be operated between sunset and sunrise and during periods of low visibility whenever the airport is open for operations. They may be operated by photocell, but this may require that the contractor turn them on manually during periods of low visibility during daytime hours.

2.20.2.3 **Supplement Barricades with Signs (for example) As Necessary.**

Examples are “No Entry” and “No Vehicles.” Be aware of the increased effects of wind and jet blast on barricades with attached signs.

2.20.2.4 **Air Operations Area – General.**

Barricades are not permitted in any active safety area or on the runway side of a runway hold line. Within a runway or taxiway object free area, and on aprons, use orange traffic cones, flashing or steady burning red lights as noted above, highly reflective collapsible barricades marked with diagonal, alternating orange and white stripes; and/or signs to separate all construction/maintenance areas from the movement area. Barricades may be supplemented with alternating orange and white flags at least 20 by 20 inch (50 by 50 cm) square and securely fastened to eliminate FOD. All barricades adjacent to any open runway or taxiway / taxilane safety area, or apron must be as low as possible to the ground, and no more than 18 inches high, exclusive of supplementary lights and flags. Barricades must be of low mass; easily collapsible upon contact with an aircraft or any of its components; and weighted or sturdily attached to the surface to prevent displacement from prop wash, jet blast, wing vortex, and other surface wind currents. If affixed to the surface, they must be frangible at grade level or as low as possible, but not to exceed 3 inch (7.6 cm) above the ground. [Figure 2-8](#) and [Figure 2-9](#) show sample barricades with proper coloring and flags.

Figure 2-8. Interlocking Barricades



Figure 2-9. Low Profile Barricades**2.20.2.5 Air Operations Area – Runway/Taxiway Intersections.**

Use highly reflective barricades with lights to close taxiways leading to closed runways. Evaluate all operating factors when determining how to mark temporary closures that can last from 10 to 15 minutes to a much longer period of time. However, even for closures of relatively short duration, close all taxiway/runway intersections with barricades. The use of traffic cones is appropriate for short duration closures.

2.20.2.6 Air Operations Area – Other.

Beyond runway and taxiway object free areas and aprons, barricades intended for construction vehicles and personnel may be many different shapes and made from various materials, including railroad ties, sawhorses, jersey barriers, or barrels.

2.20.2.7 Maintenance.

The construction specifications must include a provision requiring the contractor to have a person on call 24 hours a day for emergency maintenance of airport hazard lighting and barricades. The contractor must file the contact person's information with the airport operator. Lighting should be checked for proper operation at least once per day, preferably at dusk.

2.21 Work Zone Lighting for Nighttime Construction.

Lighting equipment must adequately illuminate the work area if the construction is to be performed during nighttime hours. Refer to [AC 150/5370-10](#) for minimum illumination levels for nighttime paving projects. Additionally, it is recommended that all support equipment, except haul trucks, be equipped with artificial illumination to safely

illuminate the area immediately surrounding their work areas. The lights should be positioned to provide the most natural color illumination and contrast with a minimum of shadows. The spacing must be determined by trial. Light towers should be positioned and adjusted to aim away from ATCT cabs and active runways to prevent blinding effects. Shielding may be necessary. Light towers should be removed from the construction site when the area is reopened to aircraft operations. Construction lighting units should be identified and generally located on the construction phasing plans in relationship to the ATCT and active runways and taxiways.

2.22 **Protection of Runway and Taxiway Safety Areas.**

Runway and taxiway safety areas, OFZs, OFAs, and approach surfaces are described in AC 150/5300-13. Protection of these areas includes limitations on the location and height of equipment and stockpiled material. An FAA airspace study may be required. Coordinate with the appropriate FAA Airports Regional or District Office if there is any doubt as to requirements or dimensions (see paragraph 2.13.5) as soon as the location and height of materials or equipment are known. The CSPP should include drawings showing all safety areas, object free areas, obstacle free zones and approach departure surfaces affected by construction.

2.22.1 Runway Safety Area (RSA).

A runway safety area is the defined surface surrounding the runway prepared or suitable for reducing the risk of damage to airplanes in the event of an undershoot, overshoot, or excursion from the runway (see AC 150/5300-13). Construction activities within the existing RSA are subject to the following conditions:

- 2.22.1.1 No construction may occur within the existing RSA while the runway is open for aircraft operations. The RSA dimensions may be temporarily adjusted if the runway is restricted to aircraft operations requiring an RSA that is equal to the RSA width and length beyond the runway ends available during construction. (See AC 150/5300-13). The temporary use of declared distances and/or partial runway closures may provide the necessary RSA under certain circumstances. Coordinate with the appropriate FAA Airports Regional or District Office to have declared distances information published, and appropriate NOTAMs issued. See AC 150/5300-13 for guidance on the use of declared distances.
- 2.22.1.2 The airport operator must coordinate the adjustment of RSA dimensions as permitted above with the appropriate FAA Airports Regional or District Office and the local FAA air traffic manager and issue a NOTAM.
- 2.22.1.3 The CSPP and SPCD must provide procedures for ensuring adequate distance for protection from blasting operations, if required by operational considerations.

2.22.1.4 **Excavations.**

2.22.1.4.1 Open trenches or excavations are not permitted within the RSA while the runway is open. Backfill trenches before the runway is opened. If backfilling excavations before the runway must be opened is impracticable, cover the excavations appropriately. Covering for open trenches must be designed to allow the safe operation of the heaviest aircraft operating on the runway across the trench without damage to the aircraft.

2.22.1.4.2 Construction contractors must prominently mark open trenches and excavations at the construction site with red or orange flags, as approved by the airport operator, and light them with red lights during hours of restricted visibility or darkness.

2.22.1.5 **Erosion Control.**

Soil erosion must be controlled to maintain RSA standards, that is, the RSA must be cleared and graded and have no potentially hazardous ruts, humps, depressions, or other surface variations, and capable, under dry conditions, of supporting snow removal equipment, aircraft rescue and fire fighting equipment, and the occasional passage of aircraft without causing structural damage to the aircraft.

2.22.2 Runway Object Free Area (ROFA).

Construction, including excavations, may be permitted in the ROFA. However, equipment must be removed from the ROFA when not in use, and material should not be stockpiled in the ROFA if not necessary. Stockpiling material in the OFA requires submittal of a 7460-1 form and justification provided to the appropriate FAA Airports Regional or District Office for approval.

2.22.3 Taxiway Safety Area (TSA).

2.22.3.1 A taxiway safety area is a defined surface alongside the taxiway prepared or suitable for reducing the risk of damage to an airplane unintentionally departing the taxiway. (See AC 150/5300-13.) Since the width of the TSA is equal to the wingspan of the design aircraft, no construction may occur within the TSA while the taxiway is open for aircraft operations. The TSA dimensions may be temporarily adjusted if the taxiway is restricted to aircraft operations requiring a TSA that is equal to the TSA width available during construction. Give special consideration to TSA dimensions at taxiway turns and intersections. (see AC 150/5300-13).

2.22.3.2 The airport operator must coordinate the adjustment of the TSA width as permitted above with the appropriate FAA Airports Regional or District Office and the FAA air traffic manager and issue a NOTAM.

2.22.3.3 The CSPP and SPCD must provide procedures for ensuring adequate distance for protection from blasting operations.

2.22.3.4 **Excavations.**

1. Curves. Open trenches or excavations are not permitted within the TSA while the taxiway is open. Trenches should be backfilled before the taxiway is opened. If backfilling excavations before the taxiway must be opened is impracticable, cover the excavations appropriately. Covering for open trenches must be designed to allow the safe operation of the heaviest aircraft operating on the taxiway across the trench without damage to the aircraft.
2. Straight Sections. Open trenches or excavations are not permitted within the TSA while the taxiway is open for unrestricted aircraft operations. Trenches should be backfilled before the taxiway is opened. If backfilling excavations before the taxiway must be opened is impracticable, cover the excavations to allow the safe passage of ARFF equipment and of the heaviest aircraft operating on the taxiway across the trench without causing damage to the equipment or aircraft. In rare circumstances where the section of taxiway is indispensable for aircraft movement, open trenches or excavations may be permitted in the TSA while the taxiway is open to aircraft operations, subject to the following restrictions:
 - a. Taxiing speed is limited to 10 mph.
 - b. Appropriate NOTAMs are issued.
 - c. Marking and lighting meeting the provisions of paragraphs 2.18 and 2.20 are implemented.
 - d. Low mass, low-profile lighted barricades are installed.
 - e. Appropriate temporary orange construction signs are installed.
3. Construction contractors must prominently mark open trenches and excavations at the construction site with red or orange flags, as approved by the airport operator, and light them with red lights during hours of restricted visibility or darkness.

2.22.3.5 **Erosion control.**

Soil erosion must be controlled to maintain TSA standards, that is, the TSA must be cleared and graded and have no potentially hazardous ruts, humps, depressions, or other surface variations, and capable, under dry conditions, of supporting snow removal equipment, aircraft rescue and firefighting equipment, and the occasional passage of aircraft without causing structural damage to the aircraft.

2.22.4 Taxiway Object Free Area (TOFA).

Unlike the Runway Object Free Area, aircraft wings regularly penetrate the taxiway object free area during normal operations. Thus, the restrictions are more stringent. Except as provided below, no construction may occur within the taxiway object free area while the taxiway is open for aircraft operations.

- 2.22.4.1 The taxiway object free area dimensions may be temporarily adjusted if the taxiway is restricted to aircraft operations requiring a taxiway object free area that is equal to the taxiway object free area width available. Give special consideration to TOFA dimensions at taxiway turns and intersections.
- 2.22.4.2 Offset taxiway centerline and edge pavement markings (do not use glass beads) may be used as a temporary measure to provide the required taxiway object free area. Where offset taxiway pavement markings are provided, centerline lighting, centerline reflectors, or taxiway edge reflectors are required. Existing lighting that does not coincide with the temporary markings must be taken out of service.
- 2.22.4.3 Construction activity, including open excavations, may be accomplished without adjusting the width of the taxiway object free area, subject to the following restrictions:
 - 2.22.4.3.1 Taxiing speed is limited to 10 mph.
 - 2.22.4.3.2 NOTAMs issued advising taxiing pilots of hazard and recommending reduced taxiing speeds on the taxiway.
 - 2.22.4.3.3 Marking and lighting meeting the provisions of paragraphs 2.18 and 2.20 are implemented.
 - 2.22.4.3.4 If desired, appropriate orange construction signs are installed. See paragraph 2.18.4.2 and Appendix F.
 - 2.22.4.3.5 Five-foot clearance is maintained between equipment and materials and any part of an aircraft (includes wingtip overhang). If such clearance can only be maintained if an aircraft does not have full use of the entire taxiway width (with its main landing gear at the edge of the usable pavement), then it will be necessary to move personnel and equipment for the passage of that aircraft.
 - 2.22.4.3.6 Flaggers furnished by the contractor must be used to direct and control construction equipment and personnel to a pre-established setback distance for safe passage of aircraft, and airline and/or airport personnel. Flaggers must also be used to direct taxiing aircraft. Due to liability issues, the airport operator should require airlines to provide flaggers for directing taxiing aircraft.

2.22.5 Obstacle Free Zone (OFZ).

In general, personnel, material, and/or equipment may not penetrate the OFZ while the runway is open for aircraft operations. If a penetration to the OFZ is necessary, it may be possible to continue aircraft operations through operational restrictions. Coordinate with the FAA through the appropriate FAA Airports Regional or District Office.

2.22.6 Runway Approach/Departure Areas and Clearways.

All personnel, materials, and/or equipment must remain clear of the applicable threshold siting surfaces, as defined in AC 150/5300-13. Objects that do not penetrate these surfaces may still be obstructions to air navigation and may affect standard instrument approach procedures. Coordinate with the FAA through the appropriate FAA Airports Regional or District Office.

2.22.6.1 Construction activity in a runway approach/departure area may result in the need to partially close a runway or displace the existing runway threshold. Partial runway closure, displacement of the runway threshold, as well as closure of the complete runway and other portions of the movement area also require coordination through the airport operator with the appropriate FAA air traffic manager (FSS if non-towered) and ATO/Technical Operations (for affected NAVAIDS) and airport users.

2.22.6.2 **Caution About Partial Runway Closures.**

When filing a NOTAM for a partial runway closure, clearly state that the portion of pavement located prior to the threshold is not available for landing and departing traffic. In this case, the threshold has been moved for both landing and takeoff purposes (this is different than a displaced threshold). There may be situations where the portion of closed runway is available for taxiing only. If so, the NOTAM must reflect this condition).

2.22.6.3 **Caution About Displaced Thresholds.**

Implementation of a displaced threshold affects runway length available for aircraft landing over the displacement. Depending on the reason for the displacement (to provide obstruction clearance or RSA), such a displacement may also require an adjustment in the landing distance available and accelerate-stop distance available in the opposite direction. If project scope includes personnel, equipment, excavation, or other work within the existing RSA of any usable runway end, do not implement a displaced threshold unless arrivals and departures toward the construction activity are prohibited. Instead, implement a partial closure.

2.23 **Other Limitations on Construction.**

The CSPP must specify any other limitations on construction, including but not limited to:

2.23.1 Prohibitions.

- 2.23.1.1 No use of tall equipment (cranes, concrete pumps, and so on) unless a 7460-1 determination letter is issued for such equipment.
- 2.23.1.2 No use of open flame welding or torches unless fire safety precautions are provided and the airport operator has approved their use.
- 2.23.1.3 No use of electrical blasting caps on or within 1,000 feet (300 meters) of the airport property. See AC 150/5370-10.

2.23.2 Restrictions.

- 2.23.2.1 Construction suspension required during specific airport operations.
- 2.23.2.2 Areas that cannot be worked on simultaneously.
- 2.23.2.3 Day or night construction restrictions.
- 2.23.2.4 Seasonal construction restrictions.
- 2.23.2.5 Temporary signs not approved by the airport operator.
- 2.23.2.6 Grades changes that could result in unplanned effects on NAVAIDs.

CHAPTER 3. GUIDELINES FOR WRITING A CSPP

3.1 **General Requirements.**

The CSPP is a standalone document written to correspond with the subjects outlined in paragraph 2.4. The CSPP is organized by numbered sections corresponding to each subject listed in paragraph 2.4, and described in detail in paragraphs 2.5 - 2.23. Each section number and title in the CSPP matches the corresponding subject outlined in paragraph 2.4 (for example, 1. Coordination, 2. Phasing, 3. Areas and Operations Affected by the Construction Activity, and so on). With the exception of the project scope of work outlined in Section 2. Phasing, only subjects specific to operational safety during construction should be addressed.

3.2 **Applicability of Subjects.**

Each section should, to the extent practical, focus on the specific subject. Where an overlapping requirement spans several sections, the requirement should be explained in detail in the most applicable section. A reference to that section should be included in all other sections where the requirement may apply. For example, the requirement to protect existing underground FAA ILS cables during trenching operations could be considered FAA ATO coordination (Coordination, paragraph 2.5.3), an area and operation affected by the construction activity (Areas and Operations Affected by the Construction Activity, paragraph 2.7.1.4), a protection of a NAVAID (Protection of Navigational Aids (NAVAIDs), paragraph 2.8), or a notification to the FAA of construction activities (Notification of Construction Activities, paragraph 2.13.5.3.2). However, it is more specifically an underground utility requirement (Underground Utilities, paragraph 2.15). The procedure for protecting underground ILS cables during trenching operations should therefore be described in 2.4.2.11: “The contractor must coordinate with the local FAA System Support Center (SSC) to mark existing ILS cable routes along Runway 17-35. The ILS cables will be located by hand digging whenever the trenching operation moves within 10 feet of the cable markings.” All other applicable sections should include a reference to 2.4.2.11: “ILS cables shall be identified and protected as described in 2.4.2.11” or “See 2.4.2.11 for ILS cable identification and protection requirements.” Thus, the CSPP should be considered as a whole, with no need to duplicate responses to related issues.

3.3 **Graphical Representations.**

Construction safety drawings should be included in the CSPP as attachments. When other graphical representations will aid in supporting written statements, the drawings, diagrams, and/or photographs should also be attached to the CSPP. References should be made in the CSPP to each graphical attachment and may be made in multiple sections.

3.4 **Reference Documents.**

The CSPP must not incorporate a document by reference unless reproduction of the material in that document is prohibited. In that case, either copies of or a source for the referenced document must be provided to the contractor. Where this AC recommends references (e.g. as in paragraph 3.9) the intent is to include a reference to the corresponding section in the CSPP, not to this Advisory Circular.

3.5 **Restrictions.**

The CSPP should not be considered as a project design review document. The CSPP should also avoid mention of permanent (“as-built”) features such as pavements, markings, signs, and lighting, except when such features are intended to aid in maintaining operational safety during the construction.

3.6 **Coordination.**

Include in this section a detailed description of conferences and meetings to be held both before and during the project. Include appropriate information from AC 150/5370-12. Discuss coordination procedures and schedules for each required FAA ATO Technical Operations shutdown and restart and all required flight inspections.

3.7 **Phasing.**

Include in this section a detailed scope of work description for the project as a whole and each phase of work covered by the CSPP. This includes all locations and durations of the work proposed. Attach drawings to graphically support the written scope of work. Detail in this section the sequenced phases of the proposed construction. Include a reference to paragraph 3.8, as appropriate.

3.8 **Areas and Operations Affected by Construction.**

Focus in this section on identifying the areas and operations affected by the construction. Describe corresponding mitigation that is not covered in detail elsewhere in the CSPP. Include references to paragraphs below as appropriate. Attach drawings as necessary to graphically describe affected areas and mechanisms proposed. See Appendix F for sample operational effects tables and figures.

3.9 **NAVAID Protection.**

List in this section all NAVAID facilities that will be affected by the construction. Identify NAVAID facilities that will be placed out of service at any time prior to or during construction activities. Identify individuals responsible for coordinating each shutdown and when each facility will be out of service. Include a reference to paragraph 3.6 for FAA ATO NAVAID shutdown, restart, and flight inspection coordination. Outline in detail procedures to protect each NAVAID facility remaining in service from interference by construction activities. Include a reference to paragraph 3.14 for the

issuance of NOTAMs as required. Include a reference to paragraph 3.16 for the protection of underground cables and piping serving NAVAIDs. If temporary visual aids are proposed to replace or supplement existing facilities, include a reference to paragraph 3.19. Attach drawings to graphically indicate the affected NAVAIDs and the corresponding critical areas.

3.10 **Contractor Access.**

This will necessarily be the most extensive section of the CSPP. Provide sufficient detail so that a contractor not experienced in working on airports will understand the unique restrictions such work will require. Due to this extent, it should be broken down into subsections as described below:

3.10.1 Location of Stockpiled Construction Materials.

Describe in this section specific locations for stockpiling material. Note any height restrictions on stockpiles. Include a reference to paragraph 3.21 for hazard marking and lighting devices used to identify stockpiles. Include a reference to paragraph 3.11 for provisions to prevent stockpile material from becoming wildlife attractants. Include a reference to paragraph 3.12 for provisions to prevent stockpile material from becoming FOD. Attach drawings to graphically indicate the stockpile locations.

3.10.2 Vehicle and Pedestrian Operations.

While there are many items to be addressed in this major subsection of the CSPP, all are concerned with one main issue: keeping people and vehicles from areas of the airport where they don't belong. This includes preventing unauthorized entry to the AOA and preventing the improper movement of pedestrians or vehicles on the airport. In this section, focus on mechanisms to prevent construction vehicles and workers traveling to and from the worksite from unauthorized entry into movement areas. Specify locations of parking for both employee vehicles and construction equipment, and routes for access and haul roads. In most cases, this will best be accomplished by attaching a drawing. Quote from AC 150/5210-5 specific requirements for contractor vehicles rather than referring to the AC as a whole, and include special requirements for identifying HAZMAT vehicles. Quote from, rather than incorporate by reference, AC 150/5210-20 as appropriate to address the airport's rules for ground vehicle operations, including its training program. Discuss the airport's recordkeeping system listing authorized vehicle operators.

3.10.3 Two-Way Radio Communications.

Include a special section to identify all individuals who are required to maintain communications with Air Traffic (AT) at airports with active towers, or monitor CTAF at airports without or with closed ATCT. Include training requirements for all individuals required to communicate with AT. Individuals required to monitor AT frequencies should also be identified. If construction employees are also required to communicate by radio with Airport Operations, this procedure should be described in detail. Usage of vehicle mounted radios and/or portable radios should be addressed. Communication procedures for the event of disabled radio communication (that is, light

signals, telephone numbers, others) must be included. All radio frequencies should be identified (Tower, Ground Control, CTAF, UNICOM, ATIS, and so on).

3.10.4 Airport Security.

Address security as it applies to vehicle and pedestrian operations. Discuss TSA requirements, security badging requirements, perimeter fence integrity, gate security, and other needs. Attach drawings to graphically indicate secured and/or Security Identification Display Areas (SIDA), perimeter fencing, and available access points.

3.11 **Wildlife Management.**

Discuss in this section wildlife management procedures. Describe the maintenance of existing wildlife mitigation devices, such as perimeter fences, and procedures to limit wildlife attractants. Include procedures to notify Airport Operations of wildlife encounters. Include a reference to paragraph 3.10 for security (wildlife) fence integrity maintenance as required.

3.12 **FOD Management.**

In this section, discuss methods to control and monitor FOD: worksite housekeeping, ground vehicle tire inspections, runway sweeps, and so on. Include a reference to paragraph 3.15 for inspection requirements as required.

3.13 **HAZMAT Management.**

Describe in this section HAZMAT management procedures: fuel deliveries, spill recovery procedures, Safety Data Sheet (SDS), Material Safety Data Sheet (MSDS) or Product Safety Data Sheet (PSDS) availability, and other considerations. Any specific airport HAZMAT restrictions should also be identified. Include a reference to paragraph 3.10 for HAZMAT vehicle identification requirements. Quote from, rather than incorporate by reference, AC 150/5320-15.

3.14 **Notification of Construction Activities.**

List in this section the names and telephone numbers of points of contact for all parties affected by the construction project. We recommend a single list that includes all telephone numbers required under this section. Include emergency notification procedures for all representatives of all parties potentially impacted by the construction. Identify individual representatives – and at least one alternate – for each party. List both on-duty and off-duty contact information for each individual, including individuals responsible for emergency maintenance of airport construction hazard lighting and barricades. Describe procedures to coordinate immediate response to events that might adversely affect the operational safety of the airport (such as interrupted NAVAID service). Explain requirements for and the procedures for the issuance of Notices to Airmen (NOTAMs), notification to FAA required by 14 CFR Part 77 and Part 157 and in the event of affected NAVAIDs. For NOTAMs, identify an individual, and at least one alternate, responsible for issuing and cancelling each specific type of Notice to

Airmen (NOTAM) required. Detail notification methods for police, fire fighting, and medical emergencies. This may include 911, but should also include direct phone numbers of local police departments and nearby hospitals. Identify the E911 address of the airport and the emergency access route via haul roads to the construction site. Require the contractor to have this information available to all workers. The local Poison Control number should be listed. Procedures regarding notification of Airport Operations and/or the ARFF Department of such emergencies should be identified, as applicable. If airport radio communications are identified as a means of emergency notification, include a reference to paragraph 3.10. Differentiate between emergency and nonemergency notification of ARFF personnel, the latter including activities that affect ARFF water supplies and access roads. Identify the primary ARFF contact person and at least one alternate. If notification is to be made through Airport Operations, then detail this procedure. Include a method of confirmation from the ARFF department.

3.15 Inspection Requirements.

Describe in this section inspection requirements to ensure airfield safety compliance. Include a requirement for routine inspections by the resident engineer (RE) or other airport operator's representative and the construction contractors. If the engineering consultants and/or contractors have a Safety Officer who will conduct such inspections, identify this individual. Describe procedures for special inspections, such as those required to reopen areas for aircraft operations. Part 139 requires daily airfield inspections at certificated airports, but these may need to be more frequent when construction is in progress. Discuss the role of such inspections on areas under construction. Include a requirement to immediately remedy any deficiencies, whether caused by negligence, oversight, or project scope change.

3.16 Underground Utilities.

Explain how existing underground utilities will be located and protected. Identify each utility owner and include contact information for each company/agency in the master list. Address emergency response procedures for damaged or disrupted utilities. Include a reference to paragraph 3.14 for notification of utility owners of accidental utility disruption as required.

3.17 Penalties.

Describe in this section specific penalties imposed for noncompliance with airport rules and regulations, including the CSPP: SIDA violations, VPD, and others.

3.18 Special Conditions.

Identify any special conditions that may trigger specific safety mitigation actions outlined in this CSPP: low visibility operations, snow removal, aircraft in distress, aircraft accident, security breach, VPD, and other activities requiring construction suspension/resumption. Include a reference to paragraph 3.10 for compliance with airport safety and security measures and for radio communications as required. Include

a reference to paragraph 3.14 for emergency notification of all involved parties, including police/security, ARFF, and medical services.

3.19 Runway and Taxiway Visual Aids.

Include marking, lighting, signs, and visual NAVAIDS. Detail temporary runway and taxiway marking, lighting, signs, and visual NAVAIDS required for the construction. Discuss existing marking, lighting, signs, and visual NAVAIDS that are temporarily, altered, obliterated, or shut down. Consider non-federal facilities and address requirements for reimbursable agreements necessary for alteration of FAA facilities and for necessary flight checks. Identify temporary TORA signs or runway distance remaining signs if appropriate. Identify required temporary visual NAVAIDS such as REIL or PAPI. Quote from, rather than incorporate by reference, AC 150/5340-1, Standards for Airport Markings; AC 150/5340-18, Standards for Airport Sign Systems; and AC 150/5340-30, as required. Attach drawings to graphically indicate proposed marking, lighting, signs, and visual NAVAIDS.

3.20 Marking and Signs for Access Routes.

Detail plans for marking and signs for vehicle access routes. To the extent possible, signs should be in conformance with the Federal Highway Administration MUTCD and/or State highway specifications, not hand lettered. Detail any modifications to the guidance in the MUTCD necessary to meet frangibility/height requirements.

3.21 Hazard Marking and Lighting.

Specify all marking and lighting equipment, including when and where each type of device is to be used. Specify maximum gaps between barricades and the maximum spacing of hazard lighting. Identify one individual and at least one alternate responsible for maintenance of hazard marking and lighting equipment in the master telephone list. Include a reference to paragraph 3.14. Attach drawings to graphically indicate the placement of hazard marking and lighting equipment.

3.22 Work Zone Lighting for Nighttime Construction.

If work is to be conducted at night, specify all lighting equipment, including when and where each type of device is to be used. Indicate the direction lights are to be aimed and any directions that aiming of lights is prohibited. Specify any shielding necessary in instances where aiming is not sufficient to prevent interference with air traffic control and aircraft operations. Attach drawings to graphically indicate the placement and aiming of lighting equipment. Where the plan only indicates directions that aiming of lights is prohibited, the placement and positioning of portable lights must be proposed by the Contractor and approved by the airport operator's representative each time lights are relocated or repositioned.

3.23 Protection of Runway and Taxiway Safety Areas.

This section should focus exclusively on procedures for protecting all safety areas, including those altered by the construction: methods of demarcation, limit of access, movement within safety areas, stockpiling and trenching restrictions, and so on. Reference AC 150/5300-13, as required. Include a reference to paragraph 3.10 for procedures regarding vehicle and personnel movement within safety areas. Include a reference to paragraph 3.10 for material stockpile restrictions as required. Detail requirements for trenching, excavations, and backfill. Include a reference to paragraph 3.21 for hazard marking and lighting devices used to identify open excavations as required. If runway and taxiway closures are proposed to protect safety areas, or if temporary displaced thresholds and/or revised declared distances are used to provide the required Runway Safety Area, include a reference to paragraphs 3.14 and 3.19. Detail procedures for protecting the runway OFZ, runway OFA, taxiway OFA and runway approach surfaces including those altered by the construction: methods of demarcation, limit of cranes, storage of equipment, and so on. Quote from, rather than incorporate by reference, AC 150/5300-13, as required. Include a reference to paragraph 3.24 for height (i.e., crane) restrictions as required. One way to address the height of equipment that will move during the project is to establish a three-dimensional “box” within which equipment will be confined that can be studied as a single object. Attach drawings to graphically indicate the safety area, OFZ, and OFA boundaries.

3.24 Other Limitations on Construction.

This section should describe what limitations must be applied to each area of work and when each limitation will be applied: limitations due to airport operations, height (i.e., crane) restrictions, areas which cannot be worked at simultaneously, day/night work restrictions, winter construction, and other limitations. Include a reference to paragraph 3.7 for project phasing requirements based on construction limitations as required.

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APPENDIX A. RELATED READING MATERIAL

Obtain the latest version of the following free publications from the FAA on its Web site at <http://www.faa.gov/airports/>.

Table A-1. FAA Publications

Number	Title and Description
<u>AC 150/5200-28</u>	<i>Notices to Airmen (NOTAMs) for Airport Operators</i> Guidance for using the NOTAM System in airport reporting.
<u>AC 150/5200-30</u>	<i>Airport Field Condition Assessments and Winter Operations Safety</i> Guidance for airport owners/operators on the development of an acceptable airport snow and ice control program and on appropriate field condition reporting procedures.
<u>AC 150/5200-33</u>	<i>Hazardous Wildlife Attractants On or Near Airports</i> Guidance on locating certain land uses that might attract hazardous wildlife to public-use airports.
<u>AC 150/5210-5</u>	<i>Painting, Marking, and Lighting of Vehicles Used on an Airport</i> Guidance, specifications, and standards for painting, marking, and lighting vehicles operating in the airport air operations areas.
<u>AC 150/5210-20</u>	<i>Ground Vehicle Operations to include Taxiing or Towing an Aircraft on Airports</i> Guidance to airport operators on developing ground vehicle operation training programs.
<u>AC 150/5300-13</u>	<i>Airport Design</i> FAA standards and recommendations for airport design. Establishes approach visibility minimums as an airport design parameter, and contains the Object Free area and the obstacle free-zone criteria.
<u>AC 150/5210-24</u>	<i>Airport Foreign Object Debris (FOD) Management</i> Guidance for developing and managing an airport foreign object debris (FOD) program

Number	Title and Description
<u>AC 150/5320-15</u>	<i>Management of Airport Industrial Waste</i> Basic information on the characteristics, management, and regulations of industrial wastes generated at airports. Guidance for developing a Storm Water Pollution Prevention Plan (SWPPP) that applies best management practices to eliminate, prevent, or reduce pollutants in storm water runoff with particular airport industrial activities.
<u>AC 150/5340-1</u>	<i>Standards for Airport Markings</i> FAA standards for the siting and installation of signs on airport runways and taxiways.
<u>AC 150/5340-18</u>	<i>Standards for Airport Sign Systems</i> FAA standards for the siting and installation of signs on airport runways and taxiways.
<u>AC 150/5345-28</u>	<i>Precision Approach Path Indicator (PAPI) Systems</i> FAA standards for PAPI systems, which provide pilots with visual glide slope guidance during approach for landing.
<u>AC 150/5340-30</u>	<i>Design and Installation Details for Airport Visual Aids</i> Guidance and recommendations on the installation of airport visual aids.
<u>AC 150/5345-39</u>	<i>Specification for L-853, Runway and Taxiway Retroreflective Markers</i>
<u>AC 150/5345-44</u>	<i>Specification for Runway and Taxiway Signs</i> FAA specifications for unlighted and lighted signs for taxiways and runways.
<u>AC 150/5345-53</u>	<i>Airport Lighting Equipment Certification Program</i> Details on the Airport Lighting Equipment Certification Program (ALECP).
<u>AC 150/5345-50</u>	<i>Specification for Portable Runway and Taxiway Lights</i> FAA standards for portable runway and taxiway lights and runway end identifier lights for temporary use to permit continued aircraft operations while all or part of a runway lighting system is inoperative.
<u>AC 150/5345-55</u>	<i>Specification for L-893, Lighted Visual Aid to Indicate Temporary Runway Closure</i>

Number	Title and Description
<u>AC 150/5370-10</u>	<i>Standards for Specifying Construction of Airports</i> Standards for construction of airports, including earthwork, drainage, paving, turfing, lighting, and incidental construction.
<u>AC 150/5370-12</u>	<i>Quality Management for Federally Funded Airport Construction Projects</i>
EB 93	<i>Guidance for the Assembly and Installation of Temporary Orange Construction Signs</i>
FAA Order 5200.11	<u>FAA Airports (ARP) Safety Management System (SMS)</u> Basics for implementing SMS within ARP. Includes roles and responsibilities of ARP management and staff as well as other FAA lines of business that contribute to the ARP SMS.
FAA Certalert 98-05	<i>Grasses Attractive to Hazardous Wildlife</i> Guidance on grass management and seed selection.
FAA Form 7460-1	<u>Notice of Proposed Construction or Alteration</u>
FAA Form 7480-1	<u>Notice of Landing Area Proposal</u>
FAA Form 6000.26	National NAS Strategic Interruption Service Level Agreement, Strategic Events Coordination, Airport Sponsor Form

Obtain the latest version of the following free publications from the Electronic Code of Federal Regulations at <http://www.ecfr.gov/>.

Table A-2. Code of Federal Regulation

Number	Title
Title 14 CFR Part 77	Safe, Efficient Use and Preservation of the Navigable Airspace
Title 14 CFR Part 139	Certification of Airports
Title 49 CFR Part 1542	Airport Security

Obtain the latest version of the Manual on Uniform Traffic Control Devices from the Federal Highway Administration at <http://mutcd.fhwa.dot.gov/>.

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APPENDIX B. TERMS AND ACRONYMS**Table B-1. Terms and Acronyms**

Term	Definition
Form 7460-1	Notice of Proposed Construction or Alteration. For on-airport projects, the form submitted to the FAA regional or airports division office as formal written notification of any kind of construction or alteration of objects that affect navigable airspace, as defined in 14 CFR Part 77, <i>Safe, Efficient Use, and Preservation of the Navigable Airspace</i> . (See guidance available on the FAA web site at https://oeaaa.faa.gov .) The form may be downloaded at http://www.faa.gov/airports/resources/forms/ , or filed electronically at: https://oeaaa.faa.gov .
Form 7480-1	Notice of Landing Area Proposal. Form submitted to the FAA Airports Regional Division Office or Airports District Office as formal written notification whenever a project without an airport layout plan on file with the FAA involves the construction of a new airport; the construction, realigning, altering, activating, or abandoning of a runway, landing strip, or associated taxiway; or the deactivation or abandoning of an entire airport The form may be downloaded at http://www.faa.gov/airports/resources/forms/ .
Form 6000-26	Airport Sponsor Strategic Event Submission Form
AC	Advisory Circular
ACSI	Airport Certification Safety Inspector
ADG	Airplane Design Group
AIP	Airport Improvement Program
ALECP	Airport Lighting Equipment Certification Program
ANG	Air National Guard
AOA	Air Operations Area, as defined in 14 CFR Part 107. Means a portion of an airport, specified in the airport security program, in which security measures are carried out. This area includes aircraft movement areas, aircraft parking areas, loading ramps, and safety areas, and any adjacent areas (such as general aviation areas) that are not separated by adequate security systems, measures, or procedures. This area does not include the secured area of the airport terminal building.
ARFF	Aircraft Rescue and Fire Fighting
ARP	FAA Office of Airports
ASDA	Accelerate-Stop Distance Available
AT	Air Traffic
ATCT	Airport Traffic Control Tower
ATIS	Automatic Terminal Information Service
ATO	Air Traffic Organization
Certificated Airport	An airport that has been issued an Airport Operating Certificate by the FAA under

Term	Definition
	the authority of 14 CFR Part 139, <i>Certification of Airports</i> .
CFR	Code of Federal Regulations
Construction	The presence of construction-related personnel, equipment, and materials in any location that could infringe upon the movement of aircraft.
CSPP	Construction Safety and Phasing Plan. The overall plan for safety and phasing of a construction project developed by the airport operator, or developed by the airport operator's consultant and approved by the airport operator. It is included in the invitation for bids and becomes part of the project specifications.
CTAF	Common Traffic Advisory Frequency
Displaced Threshold	A threshold that is located at a point on the runway other than the designated beginning of the runway. The portion of pavement behind a displaced threshold is available for takeoffs in either direction or landing from the opposite direction.
DOT	Department of Transportation
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FOD	Foreign Object Debris/Damage
FSS	Flight Service Station
GA	General Aviation
HAZMAT	Hazardous Materials
HMA	Hot Mix Asphalt
IAP	Instrument Approach Procedures
IFR	Instrument Flight Rules
ILS	Instrument Landing System
LDA	Landing Distance Available
LOC	Localizer antenna array
Movement Area	The runways, taxiways, and other areas of an airport that are used for taxiing or hover taxiing, air taxiing, takeoff, and landing of aircraft, exclusive of loading aprons and aircraft parking areas (reference 14 CFR Part 139).
MSDS	Material Safety Data Sheet
MUTCD	Manual on Uniform Traffic Control Devices
NAVAID	Navigation Aid
NAVAID Critical Area	An area of defined shape and size associated with a NAVAID that must remain clear and graded to avoid interference with the electronic signal.
Non-Movement Area	The area inside the airport security fence exclusive of the Movement Area. It is important to note that the non-movement area includes pavement traversed by aircraft.

Term	Definition
NOTAM	Notices to Airmen
Obstruction	Any object/obstacle exceeding the obstruction standards specified by 14 CFR Part 77, subpart C.
OCC	Operations Control Center
OE / AAA	Obstruction Evaluation / Airport Airspace Analysis
OFA	Object Free Area. An area on the ground centered on the runway, taxiway, or taxi lane centerline provided to enhance safety of aircraft operations by having the area free of objects except for those objects that need to be located in the OFA for air navigation or aircraft ground maneuvering purposes. (See AC 150/5300-13 for additional guidance on OFA standards and wingtip clearance criteria.)
OFZ	Obstacle Free Zone. The airspace below 150 ft (45 m) above the established airport elevation and along the runway and extended runway centerline that is required to be clear of all objects, except for frangible visual NAVAIDs that need to be located in the OFZ because of their function, in order to provide clearance protection for aircraft landing or taking off from the runway and for missed approaches. The OFZ is subdivided as follows: Runway OFZ, Inner Approach OFZ, Inner Transitional OFZ, and Precision OFZ. Refer to AC 150/5300-13 for guidance on OFZ.
OSHA	Occupational Safety and Health Administration
OTS	Out of Service
P&R	Planning and Requirements Group
NPI	NAS Planning & Integration
PAPI	Precision Approach Path Indicator
PFC	Passenger Facility Charge
PLASI	Pulse Light Approach Slope Indicator
Project Proposal Summary	A clear and concise description of the proposed project or change that is the object of Safety Risk Management.
RA	Reimbursable Agreement
RE	Resident Engineer
REIL	Runway End Identifier Lights
RNAV	Area Navigation
ROFA	Runway Object Free Area
RSA	Runway Safety Area. A defined surface surrounding the runway prepared or suitable for reducing the risk of damage to airplanes in the event of an undershoot, overshoot, or excursion from the runway, in accordance with AC 150/5300-13 .
SDS	Safety Data Sheet
SIDA	Security Identification Display Area
SMS	Safety Management System

Term	Definition
SPCD	Safety Plan Compliance Document. Details developed and submitted by a contractor to the airport operator for approval providing details on how the performance of a construction project will comply with the CSPP.
SRM	Safety Risk Management
SSC	System Support Center
Taxiway Safety Area	A defined surface alongside the taxiway prepared or suitable for reducing the risk of damage to an airplane unintentionally departing the taxiway, in accordance with AC 150/5300-13 .
TDG	Taxiway Design Group
Temporary	Any condition that is not intended to be permanent.
Temporary Runway End	The beginning of that portion of the runway available for landing and taking off in one direction, and for landing in the other direction. Note the difference from a displaced threshold.
Threshold	The beginning of that portion of the runway available for landing. In some instances, the landing threshold may be displaced.
TODA	Takeoff Distance Available
TOFA	Taxiway Object Free Area
TORA	Takeoff Run Available. The length of the runway less any length of runway unavailable and/or unsuitable for takeoff run computations. See AC 150/5300-13 for guidance on declared distances.
TSA	Taxiway Safety Area, or Transportation Security Administration
UNICOM	A radio communications system of a type used at small airports.
VASI	Visual Approach Slope Indicator
VGSI	Visual Glide Slope Indicator. A device that provides a visual glide slope indicator to landing pilots. These systems include precision approach path indicator (PAPI), visual approach slope indicator (VASI), and pulse light approach slope indicator (PLASI).
VFR	Visual Flight Rules
VOR	Very High Frequency Omnidirectional Radio Range
VPD	Vehicle / Pedestrian Deviation

APPENDIX C. SAFETY AND PHASING PLAN CHECKLIST

This appendix is keyed to Chapter 2. In the electronic version of this AC, clicking on the paragraph designation in the Reference column will access the applicable paragraph. There may be instances where the CSPP requires provisions that are not covered by the list in this appendix.

This checklist is intended as an aid, not a required submittal.

Table C-1. CSPP Checklist

Coordination	Reference	Addressed?			Remarks
		Yes	No	NA	
General Considerations					
Requirements for predesign, prebid, and preconstruction conferences to introduce the subject of airport operational safety during construction are specified.	<u>2.5</u>				
Operational safety is a standing agenda item for construction progress meetings.	<u>2.5</u>				
Scheduling of the construction phases is properly addressed.	<u>2.6</u>				
Any formal agreements are established.	<u>2.5.3</u>				
Areas and Operations Affected by Construction Activity					
Drawings showing affected areas are included.	<u>2.7.1</u>				
Closed or partially closed runways, taxiways, and aprons are depicted on drawings.	<u>2.7.1.1</u>				
Access routes used by ARFF vehicles affected by the project are addressed.	<u>2.7.1.2</u>				
Access routes used by airport and airline support vehicles affected by the project are addressed.	<u>2.7.1.3</u>				
Underground utilities, including water supplies for firefighting and drainage.	<u>2.7.1.4</u>				

Coordination	Reference	Addressed?			Remarks
		Yes	No	NA	
Approach/departure surfaces affected by heights of temporary objects are addressed.	<u>2.7.1.5</u>				
Construction areas, storage areas, and access routes near runways, taxiways, aprons, or helipads are properly depicted on drawings.	<u>2.7.1</u>				
Temporary changes to taxi operations are addressed.	<u>2.7.2.1</u>				
Detours for ARFF and other airport vehicles are identified.	<u>2.7.2.2</u>				
Maintenance of essential utilities and underground infrastructure is addressed.	<u>2.7.2.3</u>				
Temporary changes to air traffic control procedures are addressed.	<u>2.7.2.4</u>				
NAVAIDs					
Critical areas for NAVAIDs are depicted on drawings.	<u>2.8</u>				
Effects of construction activity on the performance of NAVAIDs, including unanticipated power outages, are addressed.	<u>2.8</u>				
Protection of NAVAID facilities is addressed.	<u>2.8</u>				
The required distance and direction from each NAVAID to any construction activity is depicted on drawings.	<u>2.8</u>				
Procedures for coordination with FAA ATO/Technical Operations, including identification of points of contact, are included.	<u>2.8, 2.13.1, 2.13.5.3.1, 2.18.1</u>				
Contractor Access					
The CSPP addresses areas to which contractor will have access and how	<u>2.9</u>				

Coordination	Reference	Addressed?			Remarks
		Yes	No	NA	
the areas will be accessed.					
The application of 49 CFR Part 1542 Airport Security, where appropriate, is addressed.	<u>2.9</u>				
The location of stockpiled construction materials is depicted on drawings.	<u>2.9.1</u>				
The requirement for stockpiles in the ROFA to be approved by FAA is included.	<u>2.9.1</u>				
Requirements for proper stockpiling of materials are included.	<u>2.9.1</u>				
Construction site parking is addressed.	<u>2.9.2.1</u>				
Construction equipment parking is addressed.	<u>2.9.2.2</u>				
Access and haul roads are addressed.	<u>2.9.2.3</u>				
A requirement for marking and lighting of vehicles to comply with <i>AC 150/5210-5, Painting, Marking and Lighting of Vehicles Used on an Airport</i> , is included.	<u>2.9.2.4</u>				
Proper vehicle operations, including requirements for escorts, are described.	<u>2.9.2.5, 2.9.2.6</u>				
Training requirements for vehicle drivers are addressed.	<u>2.9.2.7</u>				
Two-way radio communications procedures are described.	<u>2.9.2.9</u>				
Maintenance of the secured area of the airport is addressed.	<u>2.9.2.10</u>				
Wildlife Management					
The airport operator's wildlife management procedures are addressed.	<u>2.10</u>				

Coordination	Reference	Addressed?			Remarks
		Yes	No	NA	
Foreign Object Debris Management					
The airport operator's FOD management procedures are addressed.	<u>2.11</u>				
Hazardous Materials Management					
The airport operator's hazardous materials management procedures are addressed.	<u>2.12</u>				
Notification of Construction Activities					
Procedures for the immediate notification of airport user and local FAA of any conditions adversely affecting the operational safety of the airport are detailed.	<u>2.13</u>				
Maintenance of a list by the airport operator of the responsible representatives/points of contact for all involved parties and procedures for contacting them 24 hours a day, seven days a week is specified.	<u>2.13.1</u>				
A list of local ATO/Technical Operations personnel is included.	<u>2.13.1</u>				
A list of ATCT managers on duty is included.	<u>2.13.1</u>				
A list of authorized representatives to the OCC is included.	<u>2.13.2</u>				
Procedures for coordinating, issuing, maintaining and cancelling by the airport operator of NOTAMS about airport conditions resulting from construction are included.	<u>2.8, 2.13.2, 2.18.3.3.9</u>				
Provision of information on closed or hazardous conditions on airport movement areas by the airport operator to the OCC is specified.	<u>2.13.2</u>				
Emergency notification procedures for medical, fire fighting, and police	<u>2.13.3</u>				

Coordination	Reference	Addressed?			Remarks
		Yes	No	NA	
response are addressed.					
Coordination with ARFF personnel for non-emergency issues is addressed.	<u>2.13.4</u>				
Notification to the FAA under 14 CFR parts 77 and 157 is addressed.	<u>2.13.5</u>				
Reimbursable agreements for flight checks and/or design and construction for FAA owned NAVAIDs are addressed.	<u>2.13.5.3.2</u>				
Inspection Requirements					
Daily and interim inspections by both the airport operator and contractor are specified.	<u>2.14.1, 2.14.2</u>				
Final inspections at certificated airports are specified when required.	<u>2.14.3</u>				
Underground Utilities					
Procedures for protecting existing underground facilities in excavation areas are described.	<u>2.15</u>				
Penalties					
Penalty provisions for noncompliance with airport rules and regulations and the safety plans are detailed.	<u>2.16</u>				
Special Conditions					
Any special conditions that affect the operation of the airport or require the activation of any special procedures are addressed.	<u>2.17</u>				
Runway and Taxiway Visual Aids - Marking, Lighting, Signs, and Visual NAVAIDs					
The proper securing of temporary airport markings, lighting, signs, and visual NAVAIDs is addressed.	<u>2.18.1</u>				
Frangibility of airport markings, lighting, signs, and visual NAVAIDs is specified.	<u>2.18.1, 2.18.3, 2.18.4.2, 2.20.2.4</u>				

Coordination	Reference	Addressed?			Remarks
		Yes	No	NA	
The requirement for markings to be in compliance with <u>AC 150/5340-1</u> , <i>Standards for Airport Markings</i> , is specified.	<u>2.18.2</u>				
Detailed specifications for materials and methods for temporary markings are provided.	<u>2.18.2</u>				
The requirement for lighting to conform to <u>AC 150/5340-30</u> , <i>Design and Installation Details for Airport Visual Aids</i> ; <u>AC 150/5345-50</u> , <i>Specification for Portable Runway and Taxiway Lights</i> ; and <u>AC 150/5345-53</u> , <i>Airport Lighting Certification Program</i> , is specified.	<u>2.18.3</u>				
The use of a lighted X is specified where appropriate.	<u>2.18.2.1.2</u> , <u>2.18.3.2</u>				
The requirement for signs to conform to <u>AC 150/5345-44</u> , <i>Specification for Runway and Taxiway Signs</i> ; <u>AC 150/5340-18</u> , <i>Standards for Airport Sign Systems</i> ; and <u>AC 150/5345-53</u> , <i>Airport Lighting Certification Program</i> , is specified.	<u>2.18.4</u>				
Marking and Signs For Access Routes					
The CSPP specifies that pavement markings and signs intended for construction personnel should conform to <u>AC 150/5340-18</u> and, to the extent practicable, with the MUTCD and/or State highway specifications.	<u>2.18.4.2</u>				
Hazard Marking and Lighting					
Prominent, comprehensible warning indicators for any area affected by construction that is normally accessible to aircraft, personnel, or vehicles are specified.	<u>2.20.1</u>				

Coordination	Reference	Addressed?			Remarks
		Yes	No	NA	
Hazard marking and lighting are specified to identify open manholes, small areas under repair, stockpiled material, and waste areas.	<u>2.20.1</u>				
The CSPP considers less obvious construction-related hazards.	<u>2.20.1</u>				
Equipment that poses the least danger to aircraft but is sturdy enough to remain in place when subjected to typical winds, prop wash and jet blast is specified.	<u>2.20.2.1</u>				
The spacing of barricades is specified such that a breach is physically prevented barring a deliberate act.	<u>2.20.2.1</u>				
Red lights meeting the luminance requirements of the State Highway Department are specified.	<u>2.20.2.2</u>				
Barricades, temporary markers, and other objects placed and left in areas adjacent to any open runway, taxiway, taxi lane, or apron are specified to be as low as possible to the ground, and no more than 18 inch high.	<u>2.20.2.3</u>				
Barricades are specified to indicate construction locations in which no part of an aircraft may enter.	<u>2.20.2.3</u>				
Highly reflective barriers with lights are specified to barricade taxiways leading to closed runways.	<u>2.20.2.5</u>				
Markings for temporary closures are specified.	<u>2.20.2.5</u>				
The provision of a contractor's representative on call 24 hours a day for emergency maintenance of airport hazard lighting and barricades is specified.	<u>2.20.2.7</u>				

Coordination	Reference	Addressed?			Remarks
		Yes	No	NA	
Work Zone Lighting for Nighttime Construction					
If work is to be conducted at night, the CSPP identifies construction lighting units and their general locations and aiming in relationship to the ATCT and active runways and taxiways.	<u>2.21</u>				
Protection of Runway and Taxiway Safety Areas					
The CSPP clearly states that no construction may occur within a safety area while the associated runway or taxiway is open for aircraft operations.	<u>2.22.1.1</u> , <u>2.22.3.1</u>				
The CSPP specifies that the airport operator coordinates the adjustment of RSA or TSA dimensions with the ATCT and the appropriate FAA Airports Regional or District Office and issues a local NOTAM.	<u>2.22.1.2</u> , <u>2.22.3.2</u>				
Procedures for ensuring adequate distance for protection from blasting operations, if required by operational considerations, are detailed.	<u>2.22.3.3</u>				
The CSPP specifies that open trenches or excavations are not permitted within a safety area while the associated runway or taxiway is open, subject to approved exceptions.	<u>2.22.1.4</u>				
Appropriate covering of excavations in the RSA or TSA that cannot be backfilled before the associated runway or taxiway is open is detailed.	<u>2.22.1.4</u>				
The CSPP includes provisions for prominent marking of open trenches and excavations at the construction site.	<u>2.22.1.4</u>				
Grading and soil erosion control to maintain RSA/TSA standards are	<u>2.22.3.5</u>				

Coordination	Reference	Addressed?			Remarks
		Yes	No	NA	
addressed.					
The CSPP specifies that equipment is to be removed from the ROFA when not in use.	<u>2.22.2</u>				
The CSPP clearly states that no construction may occur within a taxiway safety area while the taxiway is open for aircraft operations.	<u>2.22.3</u>				
Appropriate details are specified for any construction work to be accomplished in a taxiway object free area.	<u>2.22.4</u>				
Measures to ensure that personnel, material, and/or equipment do not penetrate the OFZ or threshold siting surfaces while the runway is open for aircraft operations are included.	<u>2.22.4.3.6</u>				
Provisions for protection of runway approach/departure areas and clearways are included.	<u>2.22.6</u>				
Other Limitations on Construction					
The CSPP prohibits the use of open flame welding or torches unless adequate fire safety precautions are provided and the airport operator has approved their use.	<u>2.23.1.2</u>				
The CSPP prohibits the use of electrical blasting caps on or within 1,000 ft (300 m) of the airport property.	<u>2.23.1.3</u>				

APPENDIX D. CONSTRUCTION PROJECT DAILY SAFETY INSPECTION CHECKLIST

The situations identified below are potentially hazardous conditions that may occur during airport construction projects. Safety area encroachments, unauthorized and improper ground vehicle operations, and unmarked or uncovered holes and trenches near aircraft operating surfaces pose the most prevalent threats to airport operational safety during airport construction projects. The list below is one tool that the airport operator or contractor may use to aid in identifying and correcting potentially hazardous conditions. It should be customized as appropriate for each project including information such as the date, time and name of the person conducting the inspection.

Table D-1. Potentially Hazardous Conditions

Item	Action Required (Describe)	No Action Required (Check)
Excavation adjacent to runways, taxiways, and aprons improperly backfilled.		
Mounds of earth, construction materials, temporary structures, and other obstacles near any open runway, taxiway, or taxi lane; in the related Object Free area and aircraft approach or departure areas/zones; or obstructing any sign or marking.		
Runway resurfacing projects resulting in lips exceeding 3 inch (7.6 cm) from pavement edges and ends.		
Heavy equipment (stationary or mobile) operating or idle near AOA, in runway approaches and departures areas, or in OFZ.		
Equipment or material near NAVAIDs that may degrade or impair radiated signals and/or the monitoring of navigation and visual aids. Unauthorized or improper vehicle operations in localizer or glide slope critical areas, resulting in electronic interference and/or facility shutdown.		
Tall and especially relatively low visibility units (that is, equipment with slim profiles) — cranes, drills, and similar objects — located in critical areas, such as OFZ and		

Item	Action Required (Describe)	No Action Required (Check)
approach zones.		
Improperly positioned or malfunctioning lights or unlighted airport hazards, such as holes or excavations, on any apron, open taxiway, or open taxi lane or in a related safety, approach, or departure area.		
Obstacles, loose pavement, trash, and other debris on or near AOA. Construction debris (gravel, sand, mud, paving materials) on airport pavements may result in aircraft propeller, turbine engine, or tire damage. Also, loose materials may blow about, potentially causing personal injury or equipment damage.		
Inappropriate or poorly maintained fencing during construction intended to deter human and animal intrusions into the AOA. Fencing and other markings that are inadequate to separate construction areas from open AOA create aviation hazards.		
Improper or inadequate marking or lighting of runways (especially thresholds that have been displaced or runways that have been closed) and taxiways that could cause pilot confusion and provide a potential for a runway incursion. Inadequate or improper methods of marking, barricading, and lighting of temporarily closed portions of AOA create aviation hazards.		
Wildlife attractants — such as trash (food scraps not collected from construction personnel activity), grass seeds, tall grass, or standing water — on or near airports.		
Obliterated or faded temporary markings on active operational areas.		
Misleading or malfunctioning obstruction lights. Unlighted or unmarked obstructions in the approach to any open runway pose aviation hazards.		

Item	Action Required (Describe)	No Action Required (Check)
Failure to issue, update, or cancel NOTAMs about airport or runway closures or other construction related airport conditions.		
Failure to mark and identify utilities or power cables. Damage to utilities and power cables during construction activity can result in the loss of runway / taxiway lighting; loss of navigation, visual, or approach aids; disruption of weather reporting services; and/or loss of communications.		
Restrictions on ARFF access from fire stations to the runway / taxiway system or airport buildings.		
Lack of radio communications with construction vehicles in airport movement areas.		
Objects, regardless of whether they are marked or flagged, or activities anywhere on or near an airport that could be distracting, confusing, or alarming to pilots during aircraft operations.		
Water, snow, dirt, debris, or other contaminants that temporarily obscure or derogate the visibility of runway/taxiway marking, lighting, and pavement edges. Any condition or factor that obscures or diminishes the visibility of areas under construction.		
Spillage from vehicles (gasoline, diesel fuel, oil) on active pavement areas, such as runways, taxiways, aprons, and airport roadways.		
Failure to maintain drainage system integrity during construction (for example, no temporary drainage provided when working on a drainage system).		

Item	Action Required (Describe)	No Action Required (Check)
Failure to provide for proper electrical lockout and tagging procedures. At larger airports with multiple maintenance shifts/workers, construction contractors should make provisions for coordinating work on circuits.		
Failure to control dust. Consider limiting the amount of area from which the contractor is allowed to strip turf.		
Exposed wiring that creates an electrocution or fire ignition hazard. Identify and secure wiring, and place it in conduit or bury it.		
Site burning, which can cause possible obscuration.		
Construction work taking place outside of designated work areas and out of phase.		

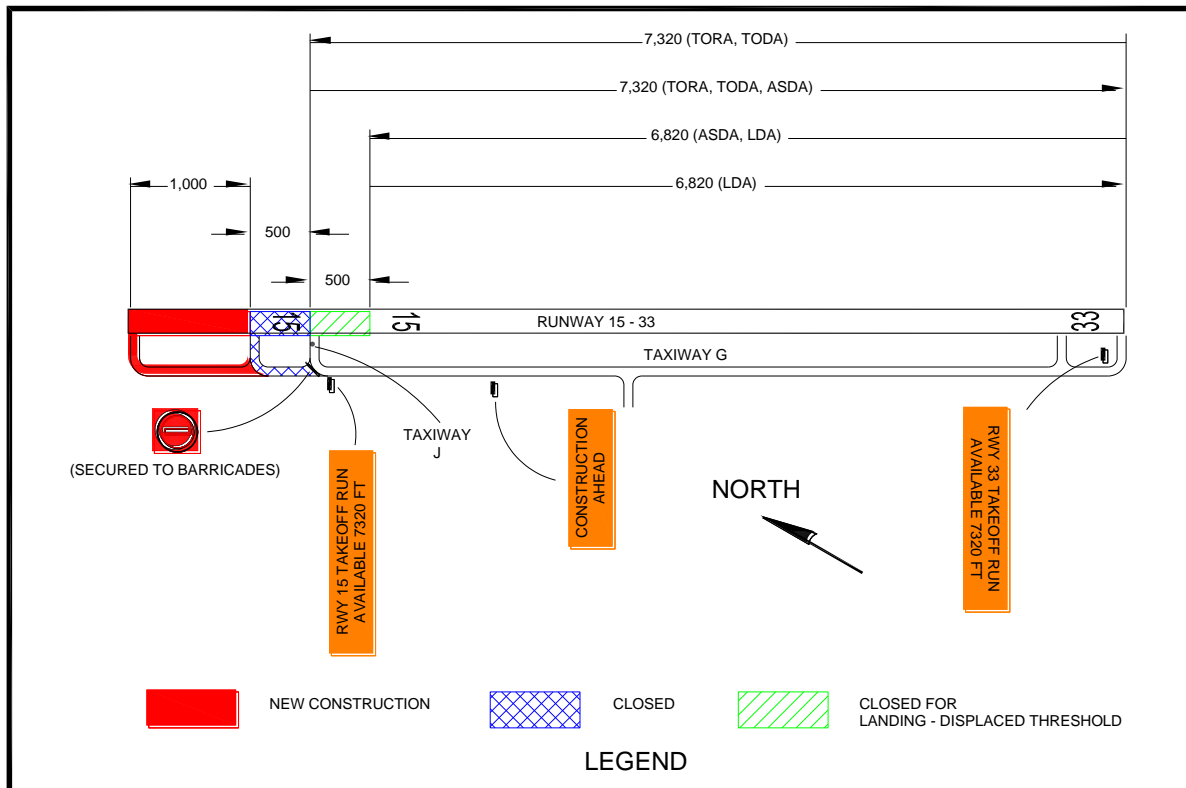
APPENDIX E. SAMPLE OPERATIONAL EFFECTS TABLE

E.1 Project Description.

Runway 15-33 is currently 7820 feet long, with a 500 foot stopway on the north end. This project will remove the stopway and extend the runway 1000 feet to the north and 500 feet to the south. Finally, the existing portion of the runway will be repaved. The runway 33 glide slope will be relocated. The new runway 33 localizer has already been installed by FAA Technical Operations and only needs to be switched on. Runway 15 is currently served only by a localizer, which will remain in operation as it will be beyond the future RSA. Appropriate NOTAMS will be issued throughout the project.

E.1.1 During Phase I, the runway 15 threshold will be displaced 1000 feet to keep construction equipment below the approach surface. The start of runway 15 takeoff and the departure end of runway 33 will also be moved 500 feet to protect workers from jet blast. Declared distances for runway 33 will be adjusted to provide the required RSA and applicable departure surface. Excavation near Taxiway G will require its ADG to be reduced from IV to III. See Figure E-1.

Figure E-1. Phase I Example

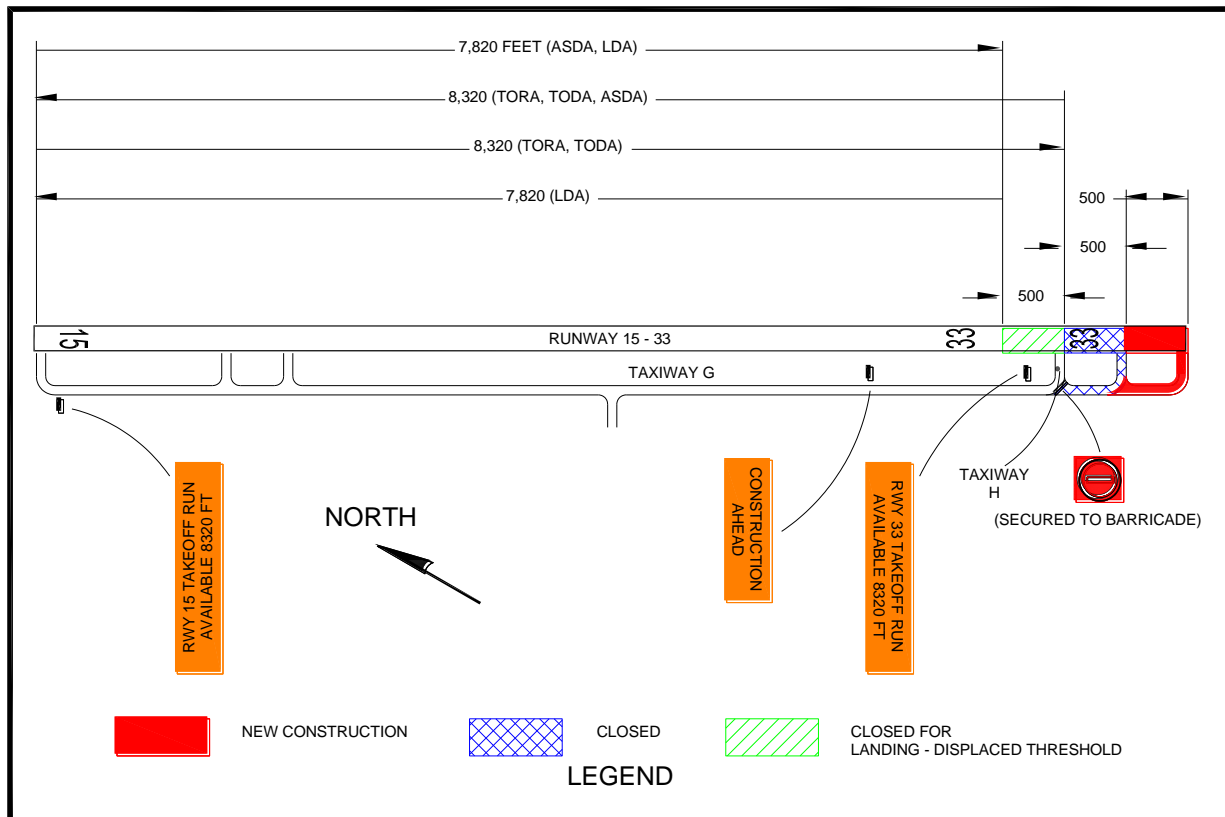


Note 1: Where hold signs are installed on both sides of a taxiway, install the TORA sign on the left side of the taxiway before the final turn to the runway intersection.

Note 2: Based on the declared distances for Runway 33 departures, the maximum equipment height in the construction area is 12.5 feet ($500/40 = 12.5$).

E.2 During Phase II, the runway 33 threshold will be displaced 1000 feet to keep construction equipment below the approach surface. The start of runway 33 takeoff and the departure end of runway 15 will also be moved 500 feet to protect workers from jet blast. Declared distances for runway 15 will be adjusted to provide the required RSA and applicable departure surface. See Figure E-2.

Figure E-2. Phase II Example



Note 1: Where hold signs are installed on both sides of a taxiway, install the TORA sign on the left side of the taxiway before the final turn to the runway intersection.

Note 2: Based on the declared distances for Runway 15 departures, the maximum equipment height in the construction area is 12.5 feet ($500/40 = 12.5$).

- E.3 During Phase III, the existing portion of the runway will be repaved with Hot Mix Asphalt (HMA) and the runway 33 glide slope will be relocated. Construction will be accomplished between the hours of 8:00 pm and 5:00 am, during which the runway will be closed to operations.

Figure E-3. Phase III Example

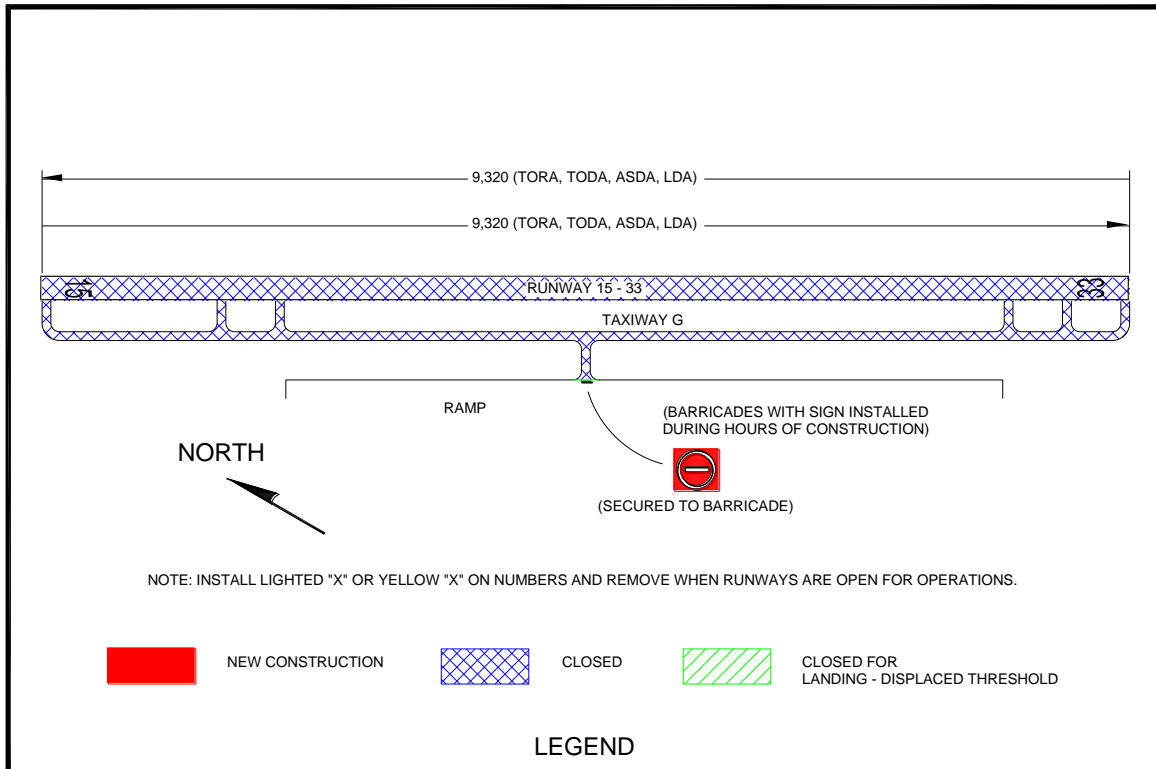


Table E-1. Operational Effects Table

Project	Runway 15-33 Extension and Repaving			
Phase	Normal (Existing)	Phase I: Extend Runway 15 End	Phase II: Extend Runway 33 End	Phase III: Repave Runway
Scope of Work	N/A	Extend Runway 15-33 1,000 ft on north end with Hot Mix Asphaltic Concrete (HMA).	Extend Runway 15-33 500 ft on south end with Hot Mix Asphaltic Concrete (HMA).	Repave existing runway with HMA Relocate Runway 33 Glide Slope
Effects of Construction Operations	N/A	Existing North 500 ft closed	Existing South 500 ft closed	Runway closed between 8:00 pm and 5:00 am Edge lighting out of service
Construction Phase	N/A	Phase I (Anticipated)	Phase II (Anticipated)	Phase III (Anticipated)
Runway 15 Average Aircraft Operations	Carrier: 52 /day GA: 26 /day Military: 11 /day	Carrier: 40 /day GA: 26 /day Military: 0 /day	Carrier: 45 /day GA: 26 /day Military: 5 /day	Carrier: 45 / day GA: 20 / day Military: 0 /day
Runway 33 Average Aircraft Operations	Carrier: 40 /day GA: 18 /day Military: 10 /day	Carrier: 30 /day GA: 18 /day Military: 0 /day	Carrier: 25 /day GA: 18 /day Military: 5 /day	Carrier: 20 /day GA: 5 /day Military: 0 /day
Runway 15-33 Aircraft Category	C-IV	C-IV	C-IV	C-IV
Runway 15 Approach Visibility Minimums	1 mile	1 mile	1 mile	1 mile
Runway 33 Approach Visibility Minimums	¾ mile	¾ mile	¾ mile	1 mile

Note: Proper coordination with Flight Procedures group is necessary to maintain instrument approach procedures during construction.

Project		Runway 15-33 Extension and Repaving			
Phase		Normal (Existing)	Phase I: Extend Runway 15 End	Phase II: Extend Runway 33 End	Phase III: Repave Runway
Runway 15 Declared Distances	TORA	7,820	7,320	8,320	9,320
	TODA	7,820	7,320	8,320	9,320
	ASDA	7,820	7,320	7,820	9,320
	LDA	7,820	6,820	7,820	9,320
Runway 33 Declared Distances	TORA	7,820	7,320	8,320	9,320
	TODA	7,820	7,320	8,320	9,320
	ASDA	8,320	6,820	8,320	9,320
	LDA	7,820	6,820	7,820	9,320
Runway 15 Approach Procedures	LOC only	LOC only	LOC only	LOC only	LOC only
	RNAV	RNAV	RNAV	RNAV	RNAV
	VOR	VOR	VOR	VOR	VOR
Runway 33 Approach Procedures	ILS	ILS	ILS	ILS	LOC only
	RNAV	RNAV	RNAV	RNAV	RNAV
	VOR	VOR	VOR	VOR	VOR
Runway 15 NAVAIDs	LOC	LOC	LOC	LOC	
Runway 33 NAVAIDs	ILS, MALSR	ILS, MALSR	ILS, MALSR	LOC, MALSR	
Taxiway G ADG	IV	III	IV	IV	
Taxiway G TDG	4	4	4	4	
ATCT (hours open)	24 hours	24 hours	24 hours	0500 - 2000	
ARFF Index	D	D	D	D	

Project	Runway 15-33 Extension and Repaving			
Phase	Normal (Existing)	Phase I: Extend Runway 15 End	Phase II: Extend Runway 33 End	Phase III: Repave Runway
Special Conditions	Air National Guard (ANG) military operations	All military aircraft relocated to alternate ANG Base	Some large military aircraft relocated to alternate ANG Base	All military aircraft relocated to alternate ANG Base
Information for NOTAMs		Refer above for applicable declared distances. Taxiway G limited to 118 ft wingspan	Refer above for applicable declared distances.	Refer above for applicable declared distances. Airport closed 2000 – 0500. Runway 15 glide slope OTS.

Note: This table is one example. It may be advantageous to develop a separate table for each project phase and/or to address the operational status of the associated NAVAIDs per construction phase.

Complete the following chart for each phase to determine the area that must be protected along the runway and taxiway edges:

Table E-2. Runway and Taxiway Edge Protection

Runway/Taxiway	Aircraft Approach Category* A, B, C, or D	Airplane Design Group* I, II, III, or IV	Safety Area Width in Feet Divided by 2*

*See AC 150/5300-13 to complete the chart for a specific runway/taxiway.

Complete the following chart for each phase to determine the area that must be protected before the runway threshold:

Table E-3. Protection Prior to Runway Threshold

Runway End Number	Airplane Design Group* I, II, III, or IV	Aircraft Approach Category* A, B, C, or D	Minimum Safety Area Prior to the Threshold*	Minimum Distance to Threshold Based on Required Approach Slope*	
				ft	: 1
			ft	ft	: 1
			ft	ft	: 1
			ft	ft	: 1
			ft	ft	: 1

*See AC 150/5300-13 to complete the chart for a specific runway.

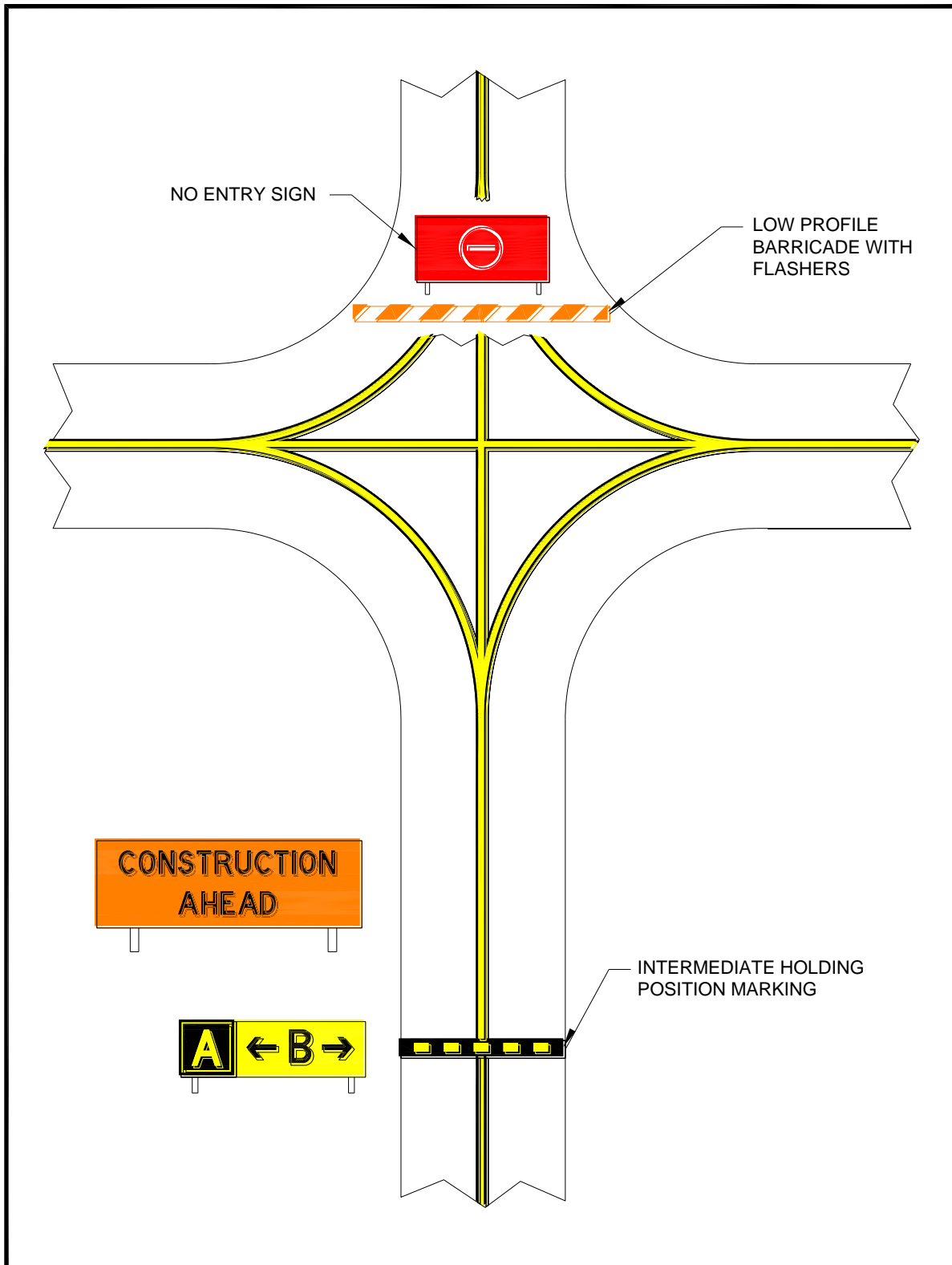
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APPENDIX F. ORANGE CONSTRUCTION SIGNS

Figure F-1. Approved Sign Legends

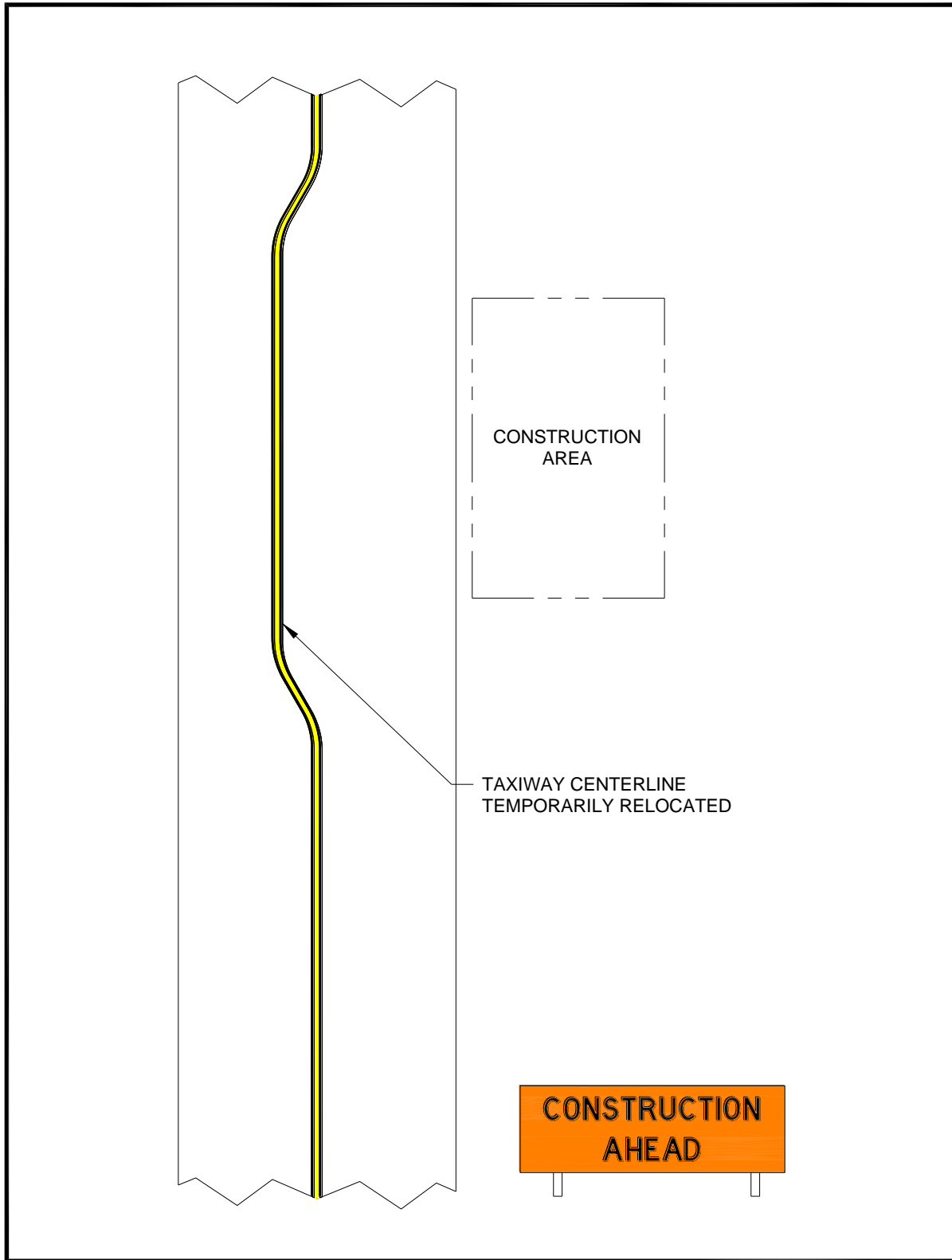


Figure F-2. Orange Construction Sign Example 1



Note: For proper placement of signs, refer to EB 93.

Figure F-3. Orange Construction Sign Example 2



Note: For proper placement of signs, refer to EB 93.

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Advisory Circular Feedback

If you find an error in this AC, have recommendations for improving it, or have suggestions for new items/subjects to be added, you may let us know by (1) mailing this form to Manager, Airport Engineering Division, Federal Aviation Administration ATTN: AAS-100, 800 Independence Avenue SW, Washington DC 20591 or (2) faxing it to the attention of the Office of Airport Safety and Standards at (202) 267-5383.

Subject: AC 150/5370-2G

Date: _____

Please check all appropriate line items:

An error (procedural or typographical) has been noted in paragraph _____ on page _____.

Recommend paragraph _____ on page _____ be changed as follows:

In a future change to this AC, please cover the following subject:
(Briefly describe what you want added.)

Other comments:

I would like to discuss the above. Please contact me at (phone number, email address).

Submitted by: _____

Date: _____

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