

CHARLOTTE COUNTY AIRPORT AUTHORITY

**BIDDING, CONTRACT DOCUMENTS,
SPECIFICATIONS & CONTRACT DRAWINGS**

FOR

**SOUTH TERMINAL EXPANSION
AND
IN-LINE BAGGAGE SYSTEM
AT THE
PUNTA GORDA AIRPORT**

**FDOT FM No.: TBD
FAA AIP NO.: N/A**

**AECOM
PROJECT NO. 60665507**

ISSUED FOR BID

FEBRUARY 2023

CONTRACT DOCUMENTS

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TO BIDDERS**

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41 CFR part 60-4
Executive Order 11246

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Minority Participation. Sponsors are required to set goals for minority participation in AIP funded projects exceeding \$10,000. The goals for minority participation derive from the Economic Area (EA) and Standard Metropolitan Statistical Area (SMSA) as established in Volume 45 of the Federal Register dated 10/3/80. Page 65984 contains a table of all EAs and SMSAs and the associated minority participation goals.

To find the goals for minority participation, a sponsor must either refer to the Federal Register Notice or to the Department of Labor online document, “Participation Goals for Minorities and Females”. EAs and SMSAs span state boundaries. A sponsor may have to refer to entries for adjacent states in order to locate the goal for the project location.

Female Participation. Executive Order 11246 has set a goal of 6.9% nationally for female participation for all construction projects. This value remains constant for all counties and states.

Civil Rights – Notice Solicitation (Title VI Solicitation Notice)

The (Charlotte County Airport Authority), in accordance with the provisions of Title VI of the Civil Rights Act of 1964 (78 Stat. 252, 42 USC §§ 2000d to 2000d-4) and the Regulations, hereby notifies all bidders or offerors that it will affirmatively ensure that any contract entered into pursuant to this advertisement, [disadvantaged business enterprises] will be afforded full and fair opportunity to submit bids in response to this invitation and will not be discriminated against on the grounds of race, color, or national origin in consideration for an award.

Federal Fair Labor Standards Act (Federal Minimum Wage)

All contracts and subcontracts that result from this solicitation incorporate by reference the provisions of 29 CFR part 201, the Federal Fair Labor Standards Act (FLSA), with the same force and effect as if given in full text. The FLSA sets minimum wage, overtime pay, recordkeeping, and child labor standards for full and part-time workers.

The *Contractor* has full responsibility to monitor compliance to the referenced statute or regulation. The *Contractor* must address any claims or disputes that arise from this requirement directly with the U.S. Department of Labor – Wage and Hour Division.

Robert D. Hancik, Chair
Publish: March 5, 2023

END OF NOTICE TO BIDDER

CHARLOTTE COUNTY AIRPORT AUTHORITY

INSTRUCTIONS TO BIDDERS

I. GENERAL

- A. This Project is to be financed in part by a grant from the United States under the Airport and Airway Safety and Capacity Act of 1987, grant from the State of Florida, **FDOT FM No. TBD**. The award of a Contract is subject to the approval of the Federal Aviation Administration and the Florida Department of Transportation.
- B. State Licenses. The successful Bidder must be a licensed Contractor and shall be required to obtain any and all necessary licenses or permits to conduct the work as may be prescribed by the State Florida.
- C. Examination of Conditions Affecting Work. Prior to submitting a Proposal, each Bidder shall examine and thoroughly familiarize himself with all existing conditions including all applicable laws, codes, ordinances, rules and regulations that will affect his work. Bidders shall visit the site, examine the grounds and all existing buildings, utilities, and roads, and shall ascertain by any reasonable means all conditions that will in any manner affect the work. The drawings have been prepared on the basis of surveys and inspections of the site, and represent an essentially accurate indication of the physical conditions at the site. This, however, shall not relieve the Bidders of ascertaining for themselves the conditions or expected site conditions for construction of the project. The Owner will not be responsible for any unforeseen conditions of the site encountered during construction.
- D. Nondiscrimination and Segregated Facilities
 - (1) Bidders must comply with the President's Executive order No. 11246 which prohibits discrimination in employment regarding race, creed, color, sex or national origin.
 - (2) Each Bidder shall complete, sign and include in his Bid Proposal the Equal Opportunity Report Statement. When a determination has been made to award a Contract to a specific Contractor, such Contractor shall, prior to award, after award or both, furnish such other pertinent information regarding his own employment policies and practices as well as those of his proposed subcontractors as the FAA, or the Secretary of Labor, and the **Charlotte County Airport Authority** may require. All such information required of a subcontractor shall be furnished by the Contractor.
 - (3) The Equal opportunity Report Statement, Certification of Non-segregated Facilities, Equal Opportunity Clause, and all other EEO requirements shall be included in all non-exempt subcontracts entered into by the Contractor. Subcontracts entered into by the Contractor shall also include all other

applicable labor provisions. No subcontract shall be awarded to a non-complying subcontractor.

- (4) In addition, the Contractor will also insert in each of his subcontracts a clause requiring the subcontractor to include these provisions in any lower tier subcontracts that may in turn be made.

E. Compliance with Law

- (1) Bidders must comply with Title IV of the Civil Rights Act of 1964, the Davis-Bacon Act, the Anti-Kickback Act and the Contract Work Hours Standard Act.
- (2) Bidders shall comply with all state laws, local ordinances, except that any preferential consideration of local in-state bidders is not allowed.

F. General Bond Requirements

- (1) The Bid Bond shall be five percent (5%) of the total amount of the bid. Only the Bid Bond as bound within these documents or a Certified Check is acceptable.
- (2) Payment and Performance Bond shall be one hundred percent (100%) of the total value of the contract. Only the payment and performance bond as bound within and made a part of the specifications and these documents is acceptable. If the value of the Contract is less than \$40,000.00, no Payment Bond or Performance Bond will be required.
- (3) The Bid Bond, Payment Bond, Performance Bond and the Bond Affidavit shall be countersigned by a Florida Resident Agent. The Florida Resident Agent shall furnish their Florida license number in the space provided.

G. Insurance Requirements

- (1) The Contractor shall maintain such insurance with insurance companies satisfactory to the **Charlotte County Airport Authority** as will protect the **Authority** from Claims under Workmen's Compensation acts and other employee benefit acts and from claims for damages because of bodily injury, including death, and from claims for property damage which may arise either out of or during operations whether such operations be by the Bidder or by any subcontractor or by anyone directly or indirectly employed by any of them. Such insurance shall not be less than the following amounts and shall include the described coverages.
 - a. Claims under worker's (workmen) compensation, disability benefit and other similar employee benefit acts. Further, Contractor shall relieve the Authority from any costs due to accidents or other

liabilities mentioned in worker's compensation act. Contractor or subcontractors with either an insufficient number of employees or in certain excluded occupational classifications are required to maintain worker's compensation coverage on a voluntary basis regardless of the statutory regulations.

- b. Claims for damages because of bodily injury, occupational sickness or disease, or death of his employees.
 - c. Claims for damages because of bodily injury, sickness or disease or death of any person other than his employees.
 - d. Claims for damages insured by usual personal injury liability coverage which are sustained (1) by any person as a result of an offense directly or indirectly related to the employment of such person by the Contractor, or (2) by another person.
 - e. Claims for damages, other than to the work itself, because of injury to or destruction of tangible property, including loss of use resulting therefrom.
 - f. 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.
- (2). The insurance required by paragraph above, shall be written for not less than the following amounts, or greater if required by law:
- a. Workmen's Compensation

Employer's Liability, Including all states

\$500,000 - each accident
\$500,000 - disease - policy limit
\$500,000 - disease - each employee
 - b. Comprehensive General Liability: shall include all major divisions of coverage and be on a comprehensive basis including:
Premises, operations, including explosion, collapse and underground;
Independent Contractor's Protective; Products and Completed Operations; Broad Form Property Damage including completed operations; Contractual Liability; Personal Injury Liability with employment exclusion deleted;

Bodily Injury and Property Damage Limits: \$1,000,000 combine single limit, or under the simplified form:

- (i) General Aggregate \$1,000,000
- (ii) Products & Completed Operators Aggregate \$1,000,000
- (iii) Products & Advertising Injury \$1,000,000
- (iv) Each Occurrence \$1,000,000
- (v) Fire Damage (Any One Fire)..... \$50,000
- (vi) Medical Expenses (Any One Person) \$5,000

Products and Completed Operations:

Insurance to be maintained for three (3) years after insurance of the final certificate for payment.

c. Mobile Equip/Comprehensive Vehicle Liability:

(owned, non-owned, and hired.)

Bodily Injury/Property Damage Combined:

\$500,000 - each occurrence

d. Umbrella Excess Liability:

The limits of liability outlined in items b and c above may be satisfied by a combination of primary and umbrella liability coverages. The total limits provided by a combination must equal or exceed \$2,000,000.

e. Owners Protection Liability Insurance: Contractor shall purchase and maintain owners protection liability insurance having limits as follows:

Each Occurrence\$ 1,000,000
Aggregate\$ 1,000,000

II. PREPARATION AND SUBMISSION OF PROPOSALS

- A. Sealed proposals, in duplicate, for the construction of the project will be received until **2:00 p.m. April 19, 2023** at the Administration Building, Charlotte County Airport Authority, **28000 Airport Road, Suite A-1, Punta Gorda, Florida 33982.**
- B. A pre-bid conference is scheduled for **10 a.m. March 14, 2023** in the Charlotte County Airport Authority Board meeting room Building 313, 7375 Utilities Road, Punta Gorda, FL. The CCAA Board meeting room is behind the Sheriff's Office.

- B. The Proposal shall be on the "Proposal Form" provided; no other forms are acceptable.
- C. Each Bidder shall present his Proposal in a sealed opaque envelope and marked at the lower left hand corner **Punta Gorda Airport Bid Proposal** with the name of the bidder.

PROPOSALS SHALL BE SUBMITTED IN DUPLICATE.

- D. The Bidder's envelope shall contain the signed original and one complete copy of the following documents:
 - 1. Proposal Form
 - 2. Bid Schedule
 - 3. Bid Bond or Certified Check
 - 4. Equal Employment Opportunity Report Statement
 - 5. Certificate of Non-Segregated Facilities
 - 6. Buy American Certificate (Jan 1991)
 - 7. Forms Listed on Page BC-2, Paragraph 9.
- E. Proposals shall be submitted as indicated by the "Proposal Form" and shall be signed in ink by an official of the firm submitting the proposal.
- F. Erasures or other changes in a Proposal shall be explained or noted over the signature of the Bidder.
- G. Proposals containing reservations, conditions, omissions, unexplained erasures or alterations, items not required in the Bid, or irregularities of any kind, may be rejected by the owner as being incomplete and not qualified for consideration.
- H. Each proposal shall indicate the full business name and address of the Bidder and shall be signed by him with the usual signature.
- I. A Proposal submitted by a partnership shall list the names of all partners and shall be signed in the partnership name by one of the members of the partnership.
- J. A Proposal submitted by a Corporation shall be signed by the legal name of the Corporation, followed by the state of incorporation and the title designation of the Corporation in legal matters. The name of each person signing the proposal shall be typed or printed below the signature.
- K. A Power of Attorney or other satisfactory evidence of the authority of the officer signing on behalf of the Corporation shall be furnished for the Owner's records.
- L. The Proposal must be accompanied by a Bid Bond executed on the form provided or a Certified Check payable to the **Charlotte County Airport Authority** in an amount

equal to not less than five percent (5%) of the bid. If a bidder is awarded the Contract, but fails, refuses, or neglects to execute the Contract or to furnish the required Payment and Performance Bonds within ten (10) days after receipt of written Notice of Award, then the amount of this Bond or check shall be paid to, or retained by, the owner as liquidated damages, although not as a penalty.

- M. Acknowledgment of receipt of all Addenda shall be made by each Bidder in the space provided in the Proposal Form.
- N. The Bidder is required to fill in all the blank spaces on the Proposal and Bid Schedule.

III. INTERPRETATIONS

- A. Each Bidder shall carefully examine the Contract Documents consisting of the Plans and Specifications, and all addenda or other revisions and thoroughly familiarize himself with the detailed requirements prior to submitting a Proposal. Should a Bidder find discrepancies or ambiguities in, or omission from Contract Documents, or should he be in doubt as to their meaning, he shall at once and, in any event not later than ten (10) days prior to bid date, notify the **Charlotte County Airport Authority** who will send written addenda to all Bidders. The **Charlotte County Airport Authority** will not be responsible for any oral instructions. All addenda sent to Bidders we become a part of Contract Documents.
- B. All inquiries shall be directed in writing to **Steven Henriquez, Project Manager with AECOM, 7650 West Courtney Campbell Causeway, Tampa, Florida 33607, Phone (813) 636-2428, Fax (813) 287-8591 and email steve.henriquez@aecom.com**. The last day for questions related to the bid documents shall be **April 11, 2023**. No allowance will be made after Bids are received for oversight by Bidder.
- C. Where a discrepancy occurs between the prices quoted in words and/or in numbers, the unit price written in words shall govern the final costs or award of Contract.

IV. MODIFICATIONS AND/OR WITHDRAWALS OF PROPOSALS

- A. A bid may not be modified, withdrawn, or canceled by the Bidder during a **ninety (90)** calendar day period following the time and date designated for the receipt of Bids, and each Bidder so agrees in submitting his bid.
- B. Negligence on the part of the Bidder in the preparation of his Proposal shall not be grounds for the modification or withdrawal of a Proposal after the time set for Bid opening.

V. ACCEPTANCE/REJECTION OF BIDS

- A. The **Charlotte County Airport Authority** proposes to award the contract to the lowest qualified Bidder submitting a reasonable bid.
- B. The **Charlotte County Airport Authority** reserves the right to waive any informalities or irregularities in or reject any or all bids and to award or refrain from awarding the Contract for the Work.

END OF INSTRUCTIONS TO BIDDERS

PROPOSAL

CHARLOTTE COUNTY AIRPORT AUTHORITY

PROPOSAL FORM

TO: **Charlotte County Airport Authority**

FROM: _____
(Bidder's Name)

(Address)

(City, State & Zip Code)

(Date)

(Phone Number)

- A. The undersigned, as Bidder, does hereby declare that he has familiarized himself with the local conditions affecting the cost of the work, Contract Documents including the "Notice to Bidders," "Instructions to Bidders," "Proposal," "Bid Schedule", General Conditions," and the Specifications and Drawings and other related Construction Documents, together with any addenda to such Construction Documents as listed herein (paragraph K) and hereby proposes to furnish all material and perform all work required in strict accordance with the provisions of documents noted above for the consideration of prices quoted in the "Bid Schedules" (see page **B-1 to B-2**).
- B. The undersigned understands that the quantities shown in the Bid Schedule are approximate only, are intended principally to serve as a guide in evaluating Proposals and are subject to either increase or decrease.
- C. The undersigned affirms that in making such Bid, neither he nor any company that he may represent, nor anyone on behalf of him or his company, directly or indirectly, has entered into any combination, collusion, undertaking or agreement with any other Bidder or Bidders to maintain the prices of said work, or any compact to prevent any other Bidder or Bidders from bidding on said contract or work and further affirms that such bid is made without regard or reference to any other Bidder or Proposal and without any agreement or understanding or combination, either directly or indirectly, with any other person or persons with reference to such bidding in any way or manner whatsoever.
- D. The undersigned further agrees that if awarded the contract he will commence the work within ten (10) calendar days after the date of the Notice to Proceed and that he will complete the work in accordance with the schedules and time frame set forth in the Contract

or such amended time as may be granted. If the undersigned fails to complete any phase of the work within the given time frame and if he fails to complete all of the work on or before the expiration of the allowed calendar days, then and in that event, he further expressly agrees that, for each day that any phase of the work under this Contract remains uncompleted thereafter, the Owner may deduct from the Contract price herein specified the stipulated sum of liquidated damages as scheduled in the Contract and retain for failure of the undersigned to complete this Contract on or before the expiration of the scheduled critical time frames.

- E. The undersigned further agrees that if awarded the Contract he will commence the work within ten (10) calendar days after the date of the Notice to Proceed.
- F. In submitting this Bid it is understood that the right is reserved by the Owner to waive formalities, technicalities and irregularities, and to reject all Bids and to negotiate with apparent qualified low Bidder if necessary. It is agreed that **THIS BID MAY NOT BE WITHDRAWN FOR A PERIOD OF NINETY (90) DAYS AFTER** the opening thereof.
- G. The undersigned has attached hereto a Certified Check, or Bid Bond in the sum of _____ (\$ _____) payable to the **Charlotte County Airport Authority**, as required in the NOTICE TO BIDDERS, and the undersigned agrees, that in case he fails to fulfill his obligations under the foregoing Bid and Contract, the **Charlotte County Airport Authority** may, at its option, determine that the undersigned has abandoned his rights and interests in such Bid and that the Cashier's Check, or Bid Bond accompanying his Bid has been forfeited. Otherwise, the Cashier's Check or Bid Bond shall be returned to the undersigned upon the execution of the Contract and the acceptance of the Bonds and Insurance, or upon rejection of his bid.
- H. The undersigned affirms that he has completed, signed and included in his Bid Proposal the following:
 - 1. Proposal Form
 - 2. Bid Schedule
 - 3. Bid Bond or Certified Check
 - 4. Equal Employment Opportunity Report Statement
 - 5. Certificate of Non-Segregated Facilities
 - 6. Buy American Certificate (Jan 1991)
 - 7. Forms Listed on Page BC-2, Paragraph 9.

A bid shall be considered unresponsive and shall be rejected if it fails to include these fully executed statements or if the Bidder fails to furnish required data. When a determination has been made to award a Contract to a specific Contractor, such Contractor shall, prior to award,

furnish such other pertinent information and assurances regarding his own employment policies and practices as well as those of his proposed subcontractors as the FAA, the Owner, the Secretary of Labor, or the office of Federal Contract Compliance (OFCC) may require.

The Bidder shall furnish similar statements executed by each of his first tier and second tier subcontractors whose contracts equal ten thousand (\$10,000.00) dollars or more and shall obtain similar compliance by such subcontractors before awarding such subcontracts. No subcontract shall be awarded to any noncomplying subcontractor.

- J. The undersigned affirms that he has completed all of the blank spaces in the Bid Schedules with an amount in words and/or numbers and agrees that where a discrepancy occurs between the prices quoted in words and/or in numbers, the unit price written in words, unless obviously incorrect, shall take precedence and govern the final costs or Award of Contract. In the case of a tie Bid Price, the Owner may negotiate a price with each low tie Bidder.

The undersigned agrees that the contract lump sum shall be decreased or increased where planned quantities shown on the drawings are decreased or increased, and that such increase or decrease shall be determined by use of the appropriate unit price if shown on the applicable Bid Schedules.

The undersigned affirms that wages not less than the minimum rates or wages, as predetermined for this project by the U. S. Secretary of Labor and County of **Charlotte**, were used in the preparation of this proposal.

- K. The undersigned acknowledges receipt of the following addenda:

<u>ADDENDA NUMBER</u>	<u>DATED</u>
_____	_____
_____	_____
_____	_____
_____	_____

continued if required.....

- L. It is understood and agreed that all workmanship and materials under all items of work are guaranteed for one (1) year from the Date of Final Acceptance, unless otherwise specified within the Contract Documents.
- M. The undersigned affirms that wages not less than the minimum rates or wages, as predetermined- for this project by the U.S. Secretary of Labor and the **Charlotte County Airport Authority**, were used in the preparation of this Proposals.

N. The legal status of the undersigned is: (The Bidder shall complete appropriate portion of form (1., 2., or 3.) and strike out the other two.)

(1) A corporation duly organized and doing business under the laws of the State of _____, for whom bearing official title of _____, whose signature is affixed to this Bid, is duly authorized to execute contracts.

If a Foreign Corporation or non State of Florida Corporation: date of qualification in _____(State).

Name and address of Process Agent: _____

(Out of State Contractor shall also provide name and address of process agent in the State of Florida.)

(2) A partnership, all of the members of which, with addresses are: (Designate general partners as such.)

_____	_____	_____
_____	_____	_____
_____	_____	_____

If all partners are non-residents of Florida: Designate name and address of agent required for service of process located in Florida.

(3) An individual, whose signature is affixed to this bid. (If non-resident of Florida, resident agent for the service of process must be designated

Dated and signed at _____,
_____, this _____ day of _____.

NAME OF BIDDER: _____

BY: _____

TITLE: _____

BUSINESS ADDRESS: _____

PHONE NO. (____) _____

FLORIDA TAX
REGISTRATION NO. _____

WITNESS: _____

END OF PROPOSAL FORM

CHARLOTTE COUNTY AIRPORT AUTHORITY

BID SCHEDULE

In accordance with all bid documents, addenda, plans, and specifications, the undersigned proposes to furnish all services, material labor, tools, equipment, and other means of construction required for the **SOUTH TERMINAL EXPANSION AND IN-LINE BAGGAGE SYSTEM**.

TOTAL PROJECT BASE BID: \$ _____

TOTAL ALTERNATE BID: \$ _____

TOTAL BASE BID PLUS ALTERNATE NO. 1 BID: \$ _____

TOTAL PROJECT BID (BASE PLUS ALT #1) WRITTEN IN WORDS:

NAME OF BIDDER: _____

BY: _____

TITLE: _____

BUSINESS: _____

ADDRESS: _____

WITNESS: _____

WITNESS: _____

The award of contract will be made to the lowest qualified bidder based upon the Base Bid or the Base Bid plus Alternate Bid, whichever is in the Authority's best interest.

The attached Bid Schedule must be completed in accordance with Appendix C Electronic Baggage Screening Program TSA Funding of Checked Baggage Inspection System, Project Costs Version 5.0.

BID SCHEDULE

OFFEROR OR CONTRACTOR COMPANY NAME							
COMPLIANCE DIRECTIONS							
The Contractor shall provide all labor, materials, tools, equipment and supervision to construct and test to the owners satisfaction the Checked Baggage Inspection Systems (CBIS) as described in the 100% bid set documents for the PGD South Terminal Expansion and Inline Baggage System. The contractor shall delineate in the below Current Working Estimate (CWE) which scope costs are TSA allocable and define the reasoning for each allocable and non-allocable portion. TSA allocable and non-allocable definitions can be found in the TSA Electronic Baggage Screening Program TSA Funding of Checked Baggage Inspection System Project Costs Version 5 (TSA Funding Memo v5) dated 10/27/2021. Allocable conveyor segments, as agreed to by TSA during the design review process, are located within the BHS drawing package. The Contractor shall populate the entirety of the Section A (Div. 34) line items [for columns D, E, F, and H] ; Column G and I will self populate. The Contractor shall only populate the "TOTAL ESTIMATE" column for the divisions in Section B. The Contractor shall also provide percentages in cells C66 through C69 for each of the contractor mark-ups. The Contractor shall populate cells H82 and H83 for the Alternate 1 and Alternate 2 bids, respectively.							

CURRENT WORKING ESTIMATE SUMMARY			Prepared by:					
AIRPORT IDENTIFIER:		PGD						
AIRPORT NAME:		Punta Gorda Airport						
PROJECT NAME:		South Terminal Expansion and In-line Baggage System						
ESTIMATED PROJECT COMPLETION DATE:		4th qtr '23	Estimate Construction Cost at Award (\$s)					
Current Working Estimate - Effective Pricing Date:			CBIS Matrix Estimate	CBRA Area Estimate	OSR Room Estimate	TOTAL ALLOCABLE ONLY (No 'NA' Included)	Non Allocable Estimate (NA)	TOTAL ESTIMATE Allocable + Non Allocable
Current Working Estimate - Level of Design:		100%						
Currency:		US						
HARD COSTS (ECCA)								
SECTION A: BAGGAGE HANDLING SYSTEM/CHECKED BAGGAGE INSPECTION SYSTEM COSTS								
Div. 34 Transportation, includes items below								
Project Management		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Equipment		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Installation		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Engineering		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Controls		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Testing		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
BHS Spare Parts Allowance		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
A. Subtotal BHS (Rounded)			\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
SECTION B: OTHER CONSTRUCTION RELATED COSTS								
Div. 1 General Requirements		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 2 Existing Conditions		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 3 Concrete		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 4 Masonry		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 5 Metals		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 6 Woods and Plastics, and Composites		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 7 Thermal and Moisture Protection		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 8 Openings		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 9 Finishes		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 10 Specialties		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 11 Equipment		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 12 Furnishings		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 13 Special Construction		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 14 Conveying Systems4		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 21 Fire Suppression		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 22 Plumbing		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 23 Heating Ventilation, and Air Conditioning		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 25 Integrated Automation		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 26 Electrical		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 27 Communications		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 28 Electronic Safety and Security		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 31 Earthwork		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 32 Exterior Improvements		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 33 Utilities		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 34 Transportation w/o BHS		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 35 Waterway and Marine Construction		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 40 Process Integration		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 41 Material Processing and Handling Equipment		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 42 Process Heating, Cooling and Drying Equipment		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 43 Process Gas and Liquid Handling, Purification and Storage Eqp.		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 44 Pollution Control Equipment		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 45 Industry Specific Manufacturing Equipment		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Div. 48 Electrical Power Generation		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
B. Subtotal Other Construction Related Costs (Rounded)			\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
SECTION C: PRIME CONTRACTOR MARK-UPS								
Insurance & Bond		0.00%	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Home Office Overhead		0.00%	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Profit		0.00%	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Sales Tax (Material only)		0.00%	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
C. Contractor Mark-ups (Rounded)			\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Hard Costs Subtotal (a + b + c)			\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
SOFT COSTS								
Construction Contingency		5.00%	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Design w/Const Admin		2.00%	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Project & Construction Management		6.00%	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Escalation		12.58%	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Soft Costs Subtotal			\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
TOTAL BASE BID (Hard + Soft Costs)			\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
ALTERNATE 1 BID (Includes Mark-ups)			\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
ALTERNATE 2 BID (Includes Mark-ups)			\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
TOTAL PROJECT BID (Does Not Include ALTERNATE 2)			\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

CHARLOTTE COUNTY AIRPORT AUTHORITY

BID BOND

(Not to be Filled out if a Certified or Cashier's Check is Submitted)

KNOW ALL MEN BY THESE PRESENTS: That we, the undersigned Bidder _____,

as Principal, and _____,
as a Corporation Surety authorized under the laws of the State of _____
to do business in the state of _____, and authorized to write this type of bond through a
resident agent of the corporation located in the State of _____, as surety, are held and
firmly bound unto the **Charlotte County Airport Authority** in the sum of _____
Dollars (\$_____) for the payment of which, well and truly to be made, we
hereby jointly and severally bind ourselves and our heirs, executors, administrators, successors and assigns.

The condition of the above obligation is such that if the attached Proposal of _____
Dollars (\$_____) for the improvement of airport facilities **FDOT FM No. 437709-1-
94-01, SOUTH TERMINAL EXPANSION AND IN-LINE BAGGAGE SYSTEM** at the **Punta
Gorda Airport**, stipulated in said Proposal in accordance with the Contract documents consisting of the Plans
and Specifications, and all addenda or other revisions, provided therefore, is accepted and the Contract
awarded to the above named Bidder, and the said Bidder shall within ten (10) calendar days after notice of
said award enter into a Contract in writing and furnish the required Payment and Performance Bonds and
insurance with surety, or sureties, to be approved by the **Charlotte County Airport Authority** this obligation
shall be void. Otherwise, the same shall be in full force and virtue of law, and the full amount of this Proposal
Bond will be paid to the **Charlotte County Airport Authority** as stipulated for liquidated damages.

Signed this _____ day of _____, _____.

(Principal must indicate whether
Corporation, Partnership, Company,
or Individual)

Principal

This person signing shall, in his own
handwriting, sign the principals name

BY:

and title. Where the person signing for
a corporation is other than the president
or vice president, that person must, by
affidavit as contained herein, show his
authority to bind the corporation.

Title

(Affix Surety's Corporate Seal)

Surety

Florida License No.

END OF BID BOND

CHARLOTTE COUNTY AIRPORT AUTHORITY

BID CONDITIONS DISADVANTAGED BUSINESS ENTERPRISE PROGRAM

The following bid conditions apply to this Department of Transportation (DOT) assisted Contract. Submission of a bid 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:** The requirements of 49 CFR Part 26, Regulations of the U.S. Department of Transportation, apply to this contract. It is the policy of the **Charlotte County Airport Authority (CCAA)** to practice nondiscrimination based on race, color, sex, or national origin in the award or performance of this contract. All firms qualifying under this solicitation are encouraged to submit bids/proposals. Award of this contract will be conditioned upon satisfying the requirements of this bid specification. These requirements apply to all Bidders including those who qualify as a DBE. The DBE contract goal of **13.4%** has been established for this contract. The Bidder/offeror shall make good faith efforts, as defined in Appendix A, 49 CFR Part 26 to meet the contract goal for DBE participation.
3. **DBE Obligation:** The contractor or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of DOT assisted contracts. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the recipient deems appropriate.
4. **Bidder's List:** The CCAA as a compliance provision of this contract, requires each Prime Bidder to provide the following information for all Subcontractors who submit quotes/bids on **FDOT FM No. 437709-1-94-01**. The Contractor agrees to provide: 1) Firm's Name; 2) Firm's Address; 3) Firm's Status as a DBE or Non DBE; 4) Firm's Age; and 5) Firm's Annual Gross Receipts and other required information for all subcontractors (DBE and Non-DBE) who submitted bids/quotes on this project on Bid Forms BF-4, BF-5, BF-6, and BF-7 (All of which shall be submitted with the Bid Proposal).
5. **Compliance:** All bidders, potential Contractors or subcontractors for this DOT-assisted Contract are hereby notified that failure to carry out the DOT policy and 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.
6. **Subcontract Clauses:** All bidders and potential Contractors hereby assure that they will include the above requirements in all subcontracts, which offer further subcontracting opportunities.
7. **Contract Award:** Bidders are hereby advised that meeting DBE subcontract goals or making an acceptable good faith effort to meet such goals are conditions of being awarded this DOT-assisted Contract.

The Owner proposes to award the Contract to the lowest responsive and responsible bidder submitting a reasonable bid provided he has met the goals for DBE participation or, if failing to meet the goals, he has made an acceptable good faith effort to meet the established goals for DBE participation. Bidder is advised that the Owner has sole authority to determine if the bidder has made sufficient effort toward meeting DBE goals to qualify for Contract award. The Owner reserves the right to reject any or all bids submitted.

8. **Available DBEs:** The Florida Department of Transportation has on file a DBE Directory which contains a list of all DBE firms certified to perform construction activities in the State of Florida. Bidders must refer to the latest DBE Directory. Bidders are encouraged to inspect this Directory to assist in locating DBEs for the work. Credit toward the DBE goals will not be counted unless the DBE to be used has been certified by the FDOT or other

qualified certifying agency.

9. **Contractor's Required Submission:** The Owner requires the submission of the following information with the bid. Certain other DBE information may also be required. The following Bid Forms must be completed and submitted with the Bid Proposal:

<u>Page #</u>	<u>Title</u>
SIA-1	DBE Subcontractor Identification Affidavit
LOI-1	Letter of Intent to Perform as a Subcontractor
SOP-1	Schedule of DBE Participation
UC-1	Disadvantaged Business Unavailability Certification
U-1	Disadvantaged Business Enterprise (DBE Utilization)

10. **DBE Good Faith Effort:** If the contractor fails to meet the DBE subcontract goals established in Paragraph 2 above, the following information must be submitted **with the bid** to assist the Owner in determining whether or not the contractor made acceptable good faith efforts to meet the contract goals. This information (when applicable), as well as the DBE information, should be submitted as specified in Paragraph 9 above.

Suggested guidance for use in determining if good faith efforts were made by a contractor are included in Appendix "A" to 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 goals follows:

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

NOTE: The nine (9) 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 made to meet the goals.

11. Contractor's Assurance: The bidder hereby assures that he will meet one of the following as appropriate:

- a) The DBE participation goals as established in Paragraph 2 above.
- b) The DBE participation percentage as shown in Paragraph 9 which was submitted as a condition of contract award.

The prime contractor agrees to pay each subcontractor under this prime contract for satisfactory performance of its contract no later than thirty (30) days from the receipt of each payment the prime contractor receives from **Charlotte County Airport Authority**. The prime contractor agrees further to return retainage payments to each subcontractor within thirty (30) 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 **Charlotte County Airport Authority**. This clause applies to both DBE and non-DBE subcontractors.

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.

12. In addition to the submission of the previous information and review by the support staff, all DBEs submitted as prime, joint venture or subcontractors will be verified through the appropriate Florida agencies and the applicable U.S. Department of Commerce Minority Business Development Association. In addition, the Owner will accept certifications made by other DOT/FAA recipients.

In the event of a DBE subcontractor replacement, Owner shall have the right to approve all substitutions of subcontractors before bid opening and during contract performance. This will be done to ensure that the contractors are eligible DBEs. In the event of a substitution, the Schedule A and/or Schedule B forms shall be submitted for the proposed replacement Contractor.

13. Disadvantaged Contractor Agencies in Florida: The following agencies are furnished for the Bidder's information for assistance in locating disadvantaged businesses:

Florida Department of Transportation: (850) 414-4747
Contact: Equal Employment Opportunity Office

Florida Minority Business Advocacy Assistance Office: (850) 487-0915

Name of Firm

Signature

Print Name

Title

Date

END OF BID CONDITIONS

CHARLOTTE COUNTY AIRPORT AUTHORITY
PRIME BIDDER'S QUALIFICATIONS

Each contractor shall furnish with his bid the following completed and signed statements on "evidence of competency" and "evidence of financial responsibility", which is in accordance with General Provision 20-02. The undersigned guarantees the truth and accuracy of all statements and answers herein contained.

1. Name of Bidder: _____
2. Business Address: _____
3. Telephone Number: _____
4. When Organized: _____
5. Where Incorporated: _____
6. How many years have you been engaged in the contracting business under the present firm name?

7. What is the type of construction work in which you are principally engaged?

8. On separate sheet list major contracts in past 10 years. Name three (3) individuals or corporations for which you have performed Work of this size and nature to which you refer:

_____ Phone _____

_____ Phone _____

_____ Phone _____
9. Have you personally inspected the proposed Work and have you a complete plan for its performance?

10. Will you sublet any part of this Work? If so, give details: _____

11. On separate sheet list equipment you own and plant available for this project. List equipment that you will purchase or rent for the proposed Work.
12. Enclose a copy of latest Financial Statement.
13. Credit Available for this Contract: \$ _____
14. Contracts now in hand, Gross Amount: \$ _____
15. Have you ever refused to sign a contract at your original bid? _____
16. Have you ever been declared in default on a contract? _____
17. Minority Business Statement: Is your firm a certified minority business enterprise as defined by the Florida Small and Minority Business Assistance Act of 1985? YES or NO

18. Remarks: _____

19. State the true, exact, correct, and complete name of the partnership, corporation, limited liability company, or trade name under which you do business, and the address of the place of business. (If a corporation, state the name of the President and Secretary. If a partnership, state the name of all partners. If a trade name, state the names of the individuals who do business under the trade name.)

(Correct Name of Bidder)

a. The business is a Sole Proprietorship, Partnership, Corporation, or Limited Liability Company.

b. The address and phone number of principal place of business is: _____

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

(The above statements must be subscribed and sworn to before a Notary Public.)

Date: _____

Firm Name: _____

By: _____

Title: _____

State of Florida General Contractor's License No.: _____

Date of Expiration: _____

Notary Public: _____

END OF PRIME BIDDER'S QUALIFICATIONS

DBE SUBCONTRACTOR IDENTIFICATION AFFIDAVIT

(Must be completed by each DBE Contractor & Subcontractor)

State of _____

County of _____

I hereby declare and affirm that I am the _____ (Title- Owner, Pres.) and duly authorized representative of _____ (Name of Firm) whose address is _____

*I hereby declare and affirm that I am a _____ Minority (or) _____ Female (specify which) Business Enterprise (MBE or WBE) as defined by the Contract Documents cited below, and that I will provide on request information to document this fact.

This firm is interested in quoting/bidding on the following categories of work being procured for the **Punta Gorda Airport, FDOT FM No. 437709-1-94-01.**

This firm has current DBE/MBE/WBE certification from the following agencies:

I DO SOLEMNLY DECLARE AND AFFIRM UNDER THE PENALTIES OF PERJURY THAT THE CONTENTS OF THE FOREGOING DOCUMENT ARE TRUE AND CORRECT AND THAT I AM AUTHORIZED ON BEHALF OF THE FIRM TO MAKE THIS AFFIDAVIT.

(Date)

(Affiant)

State of _____ County of _____

On this ____ day of _____, 20__, before me, _____, the above signed officer, personally appeared _____, known to me to be the person described in the foregoing affidavit and acknowledged that he (she) executed the same in the capacity therein stated and for the purposes therein contained.

In witness thereof I hereunto set my hand and Official Seal.

(SEAL)

My commission expires: _____

*Collectively called DBEs

LETTER OF INTENT TO PERFORM AS A SUBCONTRACTOR

(For Contractor's Submission with Bid Proposal)

TO: _____
(Name of General Contractor)

Project Name: South Terminal Expansion and In-Line Baggage System

Project No.: FDOT FM No. 437709-1-94-01

The undersigned intends to perform work in connection with the above project as: (check one)

____DBE ____Individual ____Corporation ____Partnership ____Joint Venture

The status of the undersigned is confirmed on the attached DBE Contractor Identification Affidavit.

The undersigned is prepared to perform the following described work in connection with the above project:

(Specify in detail work items or parts thereof to be performed)

at the following price: \$ _____, _____ % of the dollar value of this sub-contract will be further sublet and/or awarded to other than DBE firms.

The undersigned agrees to enter into a contract with you to perform the above work if you are awarded the prime contract.

(Name of DBE Subcontractor) (Date) _____

By: _____
(Signature)

(Firm Address)

(City & State)

Name (Typed): _____

Title: _____

END OF JOINT VENTURE ELIGIBILITY

SCHEDULE OF DBE PARTICIPATION

Name of Bidder: _____

Project No.: FDOT FM No. **437709-1-94-01**
FAA A.I.P. No. N/A

Project: **Punta Gorda Airport – South Terminal Expansion and In-Line Baggage System**

Name of DBE Subcontractor	Address	Type of Work Subcontracted	DBE	Subcontract Value
				\$
				\$
				\$
				\$
				\$
				\$

DBE Participation Total Value.....\$ _____

The undersigned will enter into a formal agreement with the DBE sub-contractors identified herein for work listed in this schedule conditioned upon execution of a contract with the **Punta Gorda Airport**.

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

Signature: _____

Title: _____

Notary Public

Name (Typed): _____

END OF SCHEDULE OF DBE PARTICIPATION

DISADVANTAGED BUSINESS UNAVAILABILITY CERTIFICATION

(Must be Completed and Submitted with Bid Proposal)

I, _____ (Name), _____ (Title) of _____
(Firm), Certify that on the dates below, I invited the following DBE subcontractor(s) to bid work items to be performed for **South Terminal Expansion and In-Line Baggage System** at the Punta Gorda Airport, **FDOT FM No. 437709-1-94-01**.

Date of Request	DBE	Name of Subcontractor	Work Items Sought

The following Subcontractors did not bid in response to the invitations:

The following Subcontractors submitted bids which were not the low responsible bid:

Date: _____ By: _____
(Signature)

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

Signed: _____ (SEAL)
Notary Public

END OF DBE UNAVAILABILITY CERTIFICATION

CHARLOTTE COUNTY AIRPORT AUTHORITY

DISADVANTAGED BUSINESS ENTERPRISE (DBE) UTILIZATION

(To be Completed and Submitted with Bid Proposal)

The undersigned bidder/offeror has satisfied the requirements of the bid specification in the following manner (please check the appropriate space):

_____ The bidder/offeror is committed to a minimum of **13.4%** DBE utilization on this contract.

_____ The bidder/offeror if unable to meet the DBE goal of **13.4%** is committed to a minimum of _____% DBE utilization on this contract and submits documentation demonstrating good faith efforts.

Name of Firm

State General Contractor's License No.

Signature

Print Name

Title

Date

END OF DBE UTILIZATION

CHARLOTTE COUNTY AIRPORT AUTHORITY

DRUG-FREE WORKPLACE COMPLIANCE FORM

IDENTICAL TIE BIDS

Preference shall be given to business with drug-free workplace programs. Whenever two or more Bids which are equal with respect to price, quality, and service are received by the State or by any political subdivision for the procurement of commodities or Contractual services, a Bid received from a business that certifies that it has implemented a drug-free Workplace program shall be given preference in the award process. Established procedures for processing tie Bids will be followed if none of the tied vendors has 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 violation of such prohibition.
2. Inform employees about the dangers of drug abuse in the workplace, the business 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, 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 a drug abuse assistance or rehabilitation program if such is available in the employer's community by, any employee who is so convicted.
6. Make a good faith effort to continue to maintain a drug-free workplace through the implementation of this section. As the person authorized to sign the statement, I certify that this firm complies fully with the above requirements.

CHARLOTTE COUNTY AIRPORT AUTHORITY
DRUG-FREE WORKPLACE COMPLIANCE FORM

Name of Firm

Signature

Print Name

Title

Date

END OF DRUG-FREE WORKPLACE COMPLIANCE FORM

CHARLOTTE COUNTY AIRPORT AUTHORITY

**STATEMENT OF ASSURANCE THAT CONTRACTOR WILL COMPLY WITH
OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)
EXCAVATION SAFETY STANDARDS (29 CFR S.1926.650, SUB-PART B) AND
FLORIDA "TRENCH SAFETY ACT"**

The undersigned agrees to perform the work in connection with the **South Terminal Expansion and In-Line Baggage System; FDOT FM No. 437709-1-94-01** project at the **Punta Gorda Airport** in compliance with current Occupational Safety and Health Administration (OSHA) Excavation Safety Standards (29 CFRs.1926.650, Sub-part B) and the Florida "Trench Safety Act".

Name of Firm

Signature

Print Name

Title

Date

END OF TRENCH SAFETY ACT

CHARLOTTE COUNTY AIRPORT AUTHORITY

NON-COLLUSIVE AFFIDAVIT

State of _____

County of _____

_____ being first duly sworn, deposes and says that:

1. He is the _____ (Owner, Partner, Officer, Representative or Agent) of _____, of the Bidder that has submitted the attached bid;
2. He is fully informed respecting the preparation and contents of the attached bid and of all pertinent circumstances respecting such bid;
3. Such bid is genuine and is not a collusive or sham bid;
4. Neither the said bidder nor any of its officers, partners, OWNERS, agents, representatives, employees or parties in interest, including this affiant, have in any way colluded, conspired, connived or agreed, directly or indirectly, with any other bidder, firm or person to submit a collusive or sham bid in connection with the work for which the attached bid has been submitted; or to refrain from bidding in connection with such work; or have in any manner, directly or indirectly, sought by agreement or collusion or communication or conference with any bidder, firm or person to fix the price or prices in the attached bid or of any other bidder or to fix any overhead, profit or cost elements of the bid price of any other bidder or to secure through any collusion, conspiracy, connivance or unlawful agreement any advantage against (recipient) or any person interested in the proposed work;
5. The price or prices quoted in the attached bid are fair and proper and are not tainted by any collusion, conspiracy, connivance or unlawful agreement on the part of the bidder of any other of its agents, representatives, OWNERS, employees or parties in interest including this affidavit.

Signature

Print Name

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

Notary Public

My Commission Expires: _____

END OF NON-COLLUSIVE AFFIDAVIT

CHARLOTTE COUNTY AIRPORT AUTHORITY

**NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO
ENSURE EQUAL EMPLOYMENT OPPORTUNITY**

1. The Offeror's or Bidder's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Opportunity Construction Contract Specifications" set forth herein.
2. The goals and timetables for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

Timetables

Goals for minority participation for each trade: **17.1%**

Goals for female participation in each trade: **6.9%**

These goals are applicable to all of the Contractor's construction work (whether or not it is Federal or federally assisted) performed in the covered area. If the Contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for such geographical area where the work is actually performed. With regard to this second area, the Contractor also is subject to the goals for both its federally involved and non-federally involved construction.

The Contractor's compliance with the Executive Order and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR 60-4.3(a) and its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the Contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, the Executive Order and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

The Contractor shall provide written notification to the Director of the Office of Federal Contract Compliance Programs (OFCCP) within 10 working days of award of any construction subcontract in excess of \$10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the name, address, and telephone number of the subcontractor; employer identification number of the subcontractor; estimated dollar amount of the subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the subcontract is to be performed.

3. As used in this notice and in the contract resulting from this solicitation, the "covered area" is

Charlotte, Lee, Collier, Sarasota, Hendry and Glades Counties in the State of Florida.

The Bidder (Proposer) shall complete the following statement by checking the appropriate blanks. Failure to complete these blanks may be grounds for rejection of bid:

1. The Bidder (Proposer) has _____ has not _____ developed and has on file at each establishment affirmative action programs pursuant to 41 CFR 601.40 and 41 CFR 60- 2.
2. The Bidder (Proposer) has _____ has not _____ participated in any previous contract or subcontract subject to the equal opportunity clause prescribed by Executive Order 111246, as amended.
3. The Bidder (Proposer) has _____ has not _____ filed with the Joint Reporting Committee the annual compliance report on Standard Form 100 (EEO-1 Report).
4. The Bidder (Proposer) does _____ does not _____ employ fifty (50) or more employees.

NAME OF BIDDER: _____

BY: _____

TITLE: _____

DATE: _____

END OF EQUAL EMPLOYMENT OPPORTUNITY

CHARLOTTE COUNTY AIRPORT AUTHORITY

CERTIFICATE OF NON-SEGREGATED FACILITIES

CERTIFICATION TO BE SUBMITTED BY CONSTRUCTION CONTRACTORS OF APPLICANTS AND THEIR SUBCONTRACTORS (APPLICABLE TO CONSTRUCTION CONTRACTS AND RELATED SUBCONTRACTS EXCEEDING TEN THOUSAND (\$10,000.00) DOLLARS (US) WHICH ARE NOT EXEMPT FROM THE EQUAL OPPORTUNITY CLAUSE.)

The federally assisted Construction Contractor certifies that he does not maintain or provide, for his employees, any segregated facilities at any of his establishments and that he does not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. The federally assisted Construction Contractor certifies that he will not maintain or provide, for his employees, segregated facilities at any of his establishments and that he will not permit his employees to perform their services at any location under his control, where segregated facilities are maintained. The federally assisted Construction Contractor 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, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directives or are in fact segregated on the basis of race, color, religion, or national origin because of habit, local custom, or any other reason. The federally assisted Construction Contractor agrees that (except where he has obtained identical certifications from proposed subcontractors for specific time periods) he will obtain identical certifications from proposed subcontractors prior to the award of subcontracts exceeding ten thousand (\$10,000.00) dollars (US) which are not exempt from the provisions of the equal opportunity clause and that he will retain such certifications in his files.

Signature of Contractor

Title

END OF CERTIFICATE OF NON-SEGREGATED FACILITIES

CHARLOTTE COUNTY AIRPORT AUTHORITY

CERTIFICATION OF COMPLIANCE WITH FAA BUY AMERICAN PREFERENCE

As a matter of bid responsiveness, the bidder or offeror must complete, sign, date, and submit this certification statement with its proposal. The bidder or offeror must indicate how it intends to comply with 49 USC § 50101, BABA and other related Made in America Laws, U.S. statutes, guidance, and FAA policies, by selecting one of the following certification statements. These statements are mutually exclusive. Bidder must select one or the other (i.e., not both) by inserting a checkmark (✓) or the letter “X”.

- ☐ Bidder or offeror hereby certifies that it will comply with 49 USC § 50101, BABA and other related U.S. statutes, guidance, and policies of the FAA by:
- a) Only installing iron, steel and manufactured products produced in the United States;
 - b) Only installing construction materials defined as: an article, material, or supply – other than an item of primarily iron or steel; a manufactured product; cement and cementitious materials; aggregates such as stone, sand, or gravel; or aggregate binding agents or additives that are or consist primarily of non-ferrous metals; plastic and polymer-based products (including polyvinylchloride, composite building materials, and polymers used in fiber optic cables); glass (including optic glass); lumber or drywall that have been manufactured in the United States.
 - c) Installing manufactured products for which the Federal Aviation Administration (FAA) has issued a waiver as indicated by inclusion on the current FAA Nationwide Buy American Waivers Issued listing; or
 - d) Installing products listed as an Excepted Article, Material or Supply in Federal Acquisition Regulation Subpart 25.108.

By selecting this certification statement, the bidder or offeror agrees:

- a) To provide to the Airport Sponsor or the FAA evidence that documents the source and origin of the iron, steel, and/or manufactured product.
 - b) To faithfully comply with providing U.S. domestic products.
 - c) To refrain from seeking a waiver request after establishment of the contract, unless extenuating circumstances emerge that the FAA determines justified.
 - d) Certify that all construction materials used in the project are manufactured in the U.S.
- ☐ The bidder or offeror hereby certifies it cannot comply with the 100 percent Buy American Preferences of 49 USC § 50101(a) but may qualify for a Type 3 or Type 4 waiver under 49 USC § 50101(b). By selecting this certification statement, the apparent bidder or offeror with the apparent low bid agrees:
- a) To submit to the Airport Sponsor or FAA within 15 calendar days of being selected as the responsive bidder, a formal waiver request and required documentation that supports the type of waiver being requested.
 - b) That failure to submit the required documentation within the specified timeframe is cause for a non-responsive determination that may result in rejection of the proposal.
 - c) To faithfully comply with providing U.S. domestic products at or above the approved U.S. domestic content percentage as approved by the FAA.

- d) To furnish U.S. domestic product for any waiver request that the FAA rejects.
- e) To refrain from seeking a waiver request after establishment of the contract, unless extenuating circumstances emerge that the FAA determines justified.

Required Documentation

Type 2 Waiver (Nonavailability) - The iron, steel, manufactured goods or construction materials or manufactured goods are not available in sufficient quantity or quality in the United States. The required documentation for the Nonavailability waiver is

- a) Completed Content Percentage Worksheet and Final Assembly Questionnaire
- b) Record of thorough market research, consideration where appropriate of qualifying alternate items, products, or materials including;
- c) A description of the market research activities and methods used to identify domestically manufactured items capable of satisfying the requirement, including the timing of the research and conclusions reached on the availability of sources.

Type 3 Waiver – The cost of components and subcomponents produced in the United States is more than 60 percent of the cost of all components and subcomponents of the “facility/project.” The required documentation for a Type 3 waiver is:

- a) Completed Content Percentage Worksheet and Final Assembly Questionnaire including;
- b) Listing of all manufactured products that are not comprised of 100 percent U.S. domestic content (excludes products listed on the FAA Nationwide Buy American Waivers Issued listing and products excluded by Federal Acquisition Regulation Subpart 25.108; products of unknown origin must be considered as non-domestic products in their entirety).
- c) Cost of non-domestic components and subcomponents, excluding labor costs associated with final assembly and installation at project location.
- d) Percentage of non-domestic component and subcomponent cost as compared to total “facility” component and subcomponent costs, excluding labor costs associated with final assembly and installation at project location.

Type 4 Waiver (Unreasonable Costs) - Applying this provision for iron, steel, manufactured goods or construction materials would increase the cost of the overall project by more than 25 percent. The required documentation for this waiver is:

- a) A completed Content Percentage Worksheet and Final Assembly Questionnaire from
- b) At minimum two comparable equal bids and/or offers;
- c) Receipt or record that demonstrates that supplier scouting called for in Executive Order 14005, indicates that no domestic source exists for the project and/or component;
- d) Completed waiver applications for each comparable bid and/or offer.

False Statements: Per 49 USC § 47126, this certification concerns a matter within the jurisdiction of the Federal Aviation Administration and the making of a false, fictitious, or fraudulent certification may render the maker subject to prosecution under Title 18, United States Code.

Date

Signature

Company Name

Title

END OF CERTIFICATION OF COMPLIANCE WITH FAA BUY AMERICAN PREFERENCE

CHARLOTTE COUNTY AIRPORT AUTHORITY

BUY AMERICAN CERTIFICATE (JAN 1991)

By submitting a Bid/Proposal under this solicitation, except for those items listed by the offeror below or on a separate and clearly identified attachment to this Bid/Proposal, the offeror certifies that steel and each manufactured product, is produced in the United States (as defined in the NOTICE TO BIDDERS - BUY AMERICAN CLAUSE "Steel and Manufactured Products for Construction Contracts") and that components of unknown origin are considered to have been produced or manufactured outside the United States.

Offerors may obtain from the Owner or their authorized representative, lists of articles, materials, and supplies excepted from this Provision.

PRODUCT

COUNTY OF ORIGIN

END OF BUY AMERICAN CERTIFICATE

**CERTIFICATION OF OFFEROR/BIDDER REGARDING TAX DELINQUENCY AND
FELONY CONVICTIONS**

The applicant must complete the following two certification statements. The applicant must indicate its current status as it relates to tax delinquency and felony conviction by inserting a checkmark (✓) in the space following the applicable response. The applicant agrees that, if awarded a contract resulting from this solicitation, it will incorporate this provision for certification in all lower tier subcontracts.

Certifications

- 1) The applicant represents that it is (☐) is not (☐) a corporation that has any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability.
- 2) The applicant represents that it is (☐) is not (☐) a corporation that was convicted of a criminal violation under any Federal law within the preceding 24 months.

Note

If an applicant responds in the affirmative to either of the above representations, the applicant is ineligible to receive an award unless the Sponsor has received notification from the agency suspension and debarment official (SDO) that the SDO has considered suspension or debarment and determined that further action is not required to protect the Government's interests. The applicant therefore must provide information to the owner about its tax liability or conviction to the Owner, who will then notify the FAA Airports District Office, which will then notify the agency's SDO to facilitate completion of the required considerations before award decisions are made.

Term Definitions

Felony conviction: Felony conviction means a conviction within the preceding twenty four (24) months of a felony criminal violation under any Federal law and includes conviction of an offense defined in a section of the U.S. Code that specifically classifies the offense as a felony and conviction of an offense that is classified as a felony under 18 USC § 3559.

Tax Delinquency: A tax delinquency is any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted, or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability.

Date

Signature

Company Name

Title

**CERTIFICATION OF OFFEROR/BIDDER REGARDING TAX DELINQUENCY AND
FELONY CONVICTIONS**

SWORN STATEMENT - PUBLIC ENTITY CRIMES

1.01 This sworn statement is submitted with Bid, Proposal or Contract No. **SOUTH
TERMINAL EXPANSION AND IN-LINE BAGGAGE SYSTEM.**

1.02 This sworn statement is submitted by _____
_____(name of entity submitting sworn statement)
whose business address is _____
_____ and (if applicable) its Federal Employer
Identification Number (FEIN) is _____.

1.03 My name is _____ (please print name of Individual
signing) and my relationship to the entity named above is _____.

1.04 I understand that a "public entity crime" is 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 with 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.

1.05 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, nonjury trial, or entry plea of guilty or nolo contendere.

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

- (1) A predecessor or successor of a person convicted of a public entity crime: or
- (2) 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.

1.07 I understand that a "person" as defined in Paragraph 287.133(1) (c), 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, employees, members, and agents who are active in management of an entity.

1.08 Based on information and belief, the statement which I have marked below is true in relation to the entity submitting this sworn statement. (Please indicate which statement applies.)

_____ Neither the entity submitting this sworn statement, nor any officers, directors, executives, partners, shareholders, employees, members, or agents who are active in management of the entity, nor any affiliate of the entity have 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 the officers, directors, executives, partners, shareholders, employees, members, or agents who are active in 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, AND (Please indicate which additional statement applies.)

_____ There has been a proceeding concerning the conviction before a hearing officer of the State of Florida, Division of Administrative Hearings, the final order entered by the hearing officer did not place the person or affiliate on the convicted vendor list. (Please attach a copy of the final order.)

_____ The person or affiliate was placed on the convicted vendor list. There has been a subsequent proceeding before a hearing officer of the State of Florida, Division of Administration Hearings. The final order entered by the hearing officer determined that it was in the public interest to remove the person or affiliate from the convicted vendor list. (Please attach a copy of the final order.)

_____ The person or affiliate has not been placed on the convicted vendor list. (Please describe any action taken by or pending with the Department of General Services.)

**SWORN STATEMENT UNDER SECTION 287.133(3) (a). FLORIDA STATUTES
ON PUBLIC ENTITY CRIMES. THIS FORM MUST BE SIGNED IN THE
PRESENCE OF A NOTARY PUBLIC OR OTHER OFFICER AUTHORIZED
TO ADMINISTER OATHS.**

(Signature) Date: _____

STATE OF _____

COUNTY OF _____

PERSONALLY APPEARED BEFORE ME, the undersigned authority, _____
who, after first being sworn by me, (name of Individual signing) affixed his/her signature in the
space provided above on this _____ day of _____, 20____.

NOTARY PUBLIC

My Commission Expires: _____

**END OF SWORN STATEMENT –
PUBLIC ENTITY CRIME**

CONTRACT

CHARLOTTE COUNTY AIRPORT AUTHORITY

CONTRACT

This Contract is made and entered into this ____ day of _____ 2023, and between **Charlotte County Airport Authority**, (hereinafter “CCAA”) and _____. (hereinafter “Contractor”). Hereinafter the CCAA and Contractor may be jointly referred to as “Parties”.

THE PARTIES hereto each in of the consideration set forth herein agree as follows:

1. Scope of Work: Contractor in consideration of the sums of money herein specified to be paid by CCAA shall and will at its own cost and expense furnish all labor, materials, tools, and equipment for **SOUTH TERMINAL EXPANSION AND IN-LINE BAGGAGE SYSTEM** at the **Punta Gorda Airport** in accordance with the applicable Plans, Specifications, Bidding and Contract Requirements, General and Supplementary General Conditions and All Addenda issued prior to opening of Bids and herein after referred to as the “Contract Documents.” The Contract Documents are hereby fully incorporated herein and made a part of this Contract.
2. Contract Amount: \$ _____
3. Acceptance: All work to be fully completed to the acceptance by the CCAA at the amount of as bid per the unit prices in the bid schedule.
4. Commencement: Contractor shall commence the work within ten (10) days of the date set by CCAA in a written Notice-To-Proceed and shall complete all work under this Contract in accordance with the schedule shown in Paragraph 6.
5. Payment: CCAA agrees to pay to Contractor for the said work as set forth in the BID SCHEDULE, at the times and manner set forth in the Contract Documents. Payments to the Contractor by CCAA shall be made upon presentation of the proper certificates to the CCAA and upon terms set forth in the Contract Documents.
6. Schedule: It is mutually agreed between the parties hereto that time is the essence of this Contract, and in the event the Construction is not substantially complete by the date specified below in COLUMN I of the CONSTRUCTION SCHEDULE, it is agreed that from any money due or to become due the Contractor or his Surety, the Owner may retain the dollar amount shown below in COLUMN II per day for each calendar day thereafter, Sundays and Holidays included, that the work remains incomplete, not as a penalty but as liquidation of a reasonable portion of damages that will be incurred by the owner by failure of the Contractor to complete the work within the times stipulated:

CONSTRUCTION SCHEDULE

COLUMN I

COLUMN II

<u>DESCRIPTION</u>	<u>CONTRACT TIME</u>	<u>LIQUIDATED DAMAGES</u>
Mobilization	30 Calendar Days	\$250.00
All Construction Phases	510 Calendar Days	\$1000.00
Substantial Completion	14 Calendar Days	\$1000.00
Total Project	554 Consecutive Calendar Days*	\$1000.00

* From Notice-to-proceed (NTP)

7. Termination: If Contractor fails to comply with any of the terms, conditions, provisions, or stipulations of this Contract, according to the true intent and meaning thereof, then CCAA may avail itself of any or all remedies provided under this Contract and shall have the right and power to proceed in accordance with the provisions thereof. CCAA may provide 10-day written notice of any deficiency or failure to perform. Failure of Contractor to rectify any deficiencies of performance work within 10 days may result in CCAA unilaterally terminating this contract, proceeding with correction and completion of this Contract with all rights reserved to seek and recover all actual and consequential damages from Contractor or Surety plus attorney fees and costs.
8. Entirety and Amendment: This Contract is the entire Contract between the Parties and shall be amended or modified only by and written contract executed with equal formality.
9. Applicable Law. This Contract and the provisions contained herein shall be construed, controlled and interpreted according to the laws of the State of Florida. The parties further agree that in the event of any litigation arising out of any alleged breach or non-performance of this Contract, the venue for such litigation shall be in Charlotte County, Florida. Nothing in this Contract shall waive any protections under sovereign immunity, Section 768.28, Florida Statutes, or any other similar provision of law.
10. Assignment: This Contract shall be binding on the parties hereto, their representatives, successors and assigns. No party shall assign this Contract or the rights or obligation hereof to any other person or entity without the written consent of the other party.
11. Third Party Beneficiaries: This Contract is solely for the benefit of the parties hereto, and no right or cause of action shall accrue upon or by reason thereof inure, to or for the benefit of any third party.
12. Severability: If any part of this Contract is found invalid or unenforceable by any court of competent jurisdiction, such invalidity or unenforceability shall not be deemed to affect the other parts of the Contract, so long as the rights and responsibilities of the parties hereto are not materially prejudiced and the intentions of the parties continue to be in effect.

13. Subsequent Breaches: A waiver by CCAA of any breach of any provision, term, condition or covenant shall not be construed as a waiver of a subsequent breach by the other party.

IN WITNESS WHEREOF, the parties to the agreement have hereunto set their hands and seals and have executed this Contract the day and year first above written in two counterparts, each of which shall without proof of accounting for the other counterpart, be deemed an original Contract.

Signed. Sealed and Delivered in the
Presence of:

**CHARLOTTE COUNTY
AIRPORT AUTHORITY**

BY: _____
James W. Parish, P.E., CEO

ATTEST BY: _____

CONTRACTOR

BY: _____

TITLE: _____
(Seal)

Contractor shall indicate whether
Corporation, Partnership, Company or
Individual

ATTEST BY: _____

TITLE: _____

The person signing shall in his own
handwriting sign the principals name,
his own name, and his title.

Where the person signing for a
corporation is other than the President,
he shall, by affidavit, number. show his
authority to bind the corporation. A
corporate seal is required for all
Companies that are incorporated.

Out-of-State contractors must affix
Florida tax registration

END OF CONTRACT

CHARLOTTE COUNTY AIRPORT AUTHORITY

PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS: that _____,
hereinafter called Contractor, and _____

_____ as surety, hereinafter called Surety, are held and firmly bound unto the **Charlotte County Airport Authority** as obligee, hereinafter called owner, in the amount of \$ _____ for the payment of which Contractor and Surety bond themselves, their heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, Contractor has by written agreement dated _____, 20____, entered into a Contract with Owner for **FDOT FM No. TBD, SOUTH TERMINAL EXPANSION AND IN-LINE BAGGAGE SYSTEM** at the **Punta Gorda Airport** in accordance with all of the Contract Documents consisting of the Plans and Specifications, and all addenda or other revisions prepared by the **Charlotte County Airport Authority**, which Contract is be reference made a part hereof and is hereinafter referred to as the Contract.

NOW, THEREFORE, the conditions of the above obligation is such that if the said contractor shall well and faithfully perform the things agreed by him to be done and performed according to the terms of said Contract, and shall promptly make payments to all persons supplying labor, material, and supplies used directly or indirectly by the said Contractor, or subcontractors, in the prosecution of the work provided for in said Contract, we agreeing and assenting that this undertaking shall be for the benefit of any subcontractor, material men, or laborer having a just claim, as well as for the Obligee herein, then this obligation shall be void, otherwise, the same shall remain in full force and effect, it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall in no event exceed the amount of this obligation as herein stated.

The said Surety hereby stipulates and agrees that no modifications, omissions, or additions, in or to the terms of said Contract or on or to the plans and specifications therefor shall in any way affect the obligation of said Surety or its Bond.

The said Surety shall inform the Owner thirty (30) days prior to expiration of this bond, by giving notice by registered mail.

Signed and sealed this _____ day of _____ 20__.

Principal must indicate whether
corporation, partnership, company
or individual)

Principal

The person signing shall, in his
own handwriting, sign the
principals name, his own
and his title. Where a person
signing for a corporation is
other than the President or Vice
President, he must, by affidavit
as contained herein, show his
authority to bind the corporation.

By: _____

Title

(Contractor's corporate seal)

(Affix Surety's corporate seal)

Surety

By: _____

_____, 20__

COUNTERSIGNED:

Florida Resident Agent

Florida License Number

(Attach "BOND AFFIDAVIT" on copy of form bound in these specifications)

END OF PAYMENT BOND

CHARLOTTE COUNTY AIRPORT AUTHORITY

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS: that _____, as Principal, hereinafter called Contractor, and _____ as Surety, hereinafter called Surety, are held and firmly bound unto the **Charlotte County Airport Authority** as obligee, hereinafter called owner, in the amount of \$_____ for the payment of which Contractor and Surety bind themselves, their heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, Contractor has by written agreement dated _____ 20__, entered into a Contract with Owner for **FDOT FM No. TBD, SOUTH TERMINAL EXPANSION AND IN-LINE BAGGAGE SYSTEM** at **Punta Gorda Airport** in accordance with all of the Contract Documents consisting of the Plans and Specifications, and all addenda or other revisions prepared by the **Charlotte County Airport Authority** which Contract is by reference made a part hereof and is hereinafter referred to as the Contract.

NOW, THEREFORE, the condition of the above obligation is such that if the said Contractor shall well and faithfully perform the things agreed by him to be done and performed according to the terms of said Contract, and shall promptly make payments to all persons supplying labor, material, and supplies used directly or indirectly by the said Contractor, or subcontractors, in the prosecution of the work provided for in said Contract, we agreeing and assenting that this undertaking shall be for the benefit of any subcontractor, material men, or laborer having a just claim, as well as for the Obligee herein, then this obligation shall be void, otherwise, the same shall remain in full force and effect, it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall in no event exceed the amount of this obligation as herein stated.

The said Surety hereby stipulates and agrees that no modifications, omissions, or additions, in or to the terms of said contract or on or to the plans and specifications therefor shall in any way affect the obligation of said Surety or its Bond.

The said Surety further stipulates and agrees that in the event of a default or deficiency on the part of the Contractor amounting to a breach of the Contract, the owner may, by giving notice by registered mail to Contractor and Surety, require that such default or deficiencies be remedied within ten (10) days from the date of such notice. Failure so to remedy or to take proper steps to remedy such defaults or deficiencies within said period shall be cause for the Owner to require that Surety take over and prosecute the work under the Contract and to take over all obligations pertaining thereto. In the event the work under the Contract is taken over by the Surety in a manner satisfactory to the Owner, the owner will pay to the Surety henceforth all amounts due and to become due under the Contract, including amendments, less the balance of the Contract price previously paid to the Contractor and less liquidated damages, if assessed. The owner shall not be liable for any monies not due on the Contract and shall not be made a party to any dispute between Contractor and Surety.

If the Surety does not take over the work in a satisfactory manner within ten (10) days after the notice of default or does not proceed with completing the work in accordance with the Contract, the Owner shall

have full power and authority, without impairing the obligation of the Contract or the Contract Bond, to take over the completion of the work; to appropriate or use any or all material and equipment that may be suitable; to enter into agreements and provisions thereof; or to use such other methods as may be required for completion of the Contract. The Contractor and his Surety shall be liable for all costs incurred by the owner in completing the work and for all liquidated damages in conformity with the terms of the Contract. If the sum of such liquidated damages and the expense so incurred by the Owner is less than the sum which would have been payable under this Contract if it had been completed by the Contractor or his Surety, the Contractor or his Surety shall be entitled to receive the difference; and if the sum of such expense and such liquidated damages exceeds the sum which would have been payable under the Contract, the Contractor and his Surety shall be liable and shall pay to the Owner the amount of such excess. Notice to the Contractor shall be deemed to have been served when delivered to the man in charge of any office used by the Contractor, his representative at or near the work, or by registered mail addressed to the Contractor at his last known place of business.

The said Surety further stipulates and agrees that this bond is also given and made as a guarantee insuring the owner against loss resulting from costs of repairing, replacing, or reconstructing any portion of the work performed or equipment furnished under the Contract, because of failure to perform as specified or from being defective in any manner whatsoever. This bond shall remain in full force and effect for a period of one year after the date of written recommendation and of acceptance by the Owner.

The said Surety shall inform the Owner thirty (30) days prior to expiration of this bond, by giving notice by registered mail.

Signed and sealed this _____ day of _____, 20__.

Principal must indicate whether
corporation, partnership,
company or individual

Principal

The person signing shall, in his own handwriting, sign the principals name, his own name, and his title. Where a person signing for a corporation is other than the President or Vice President, he must, by affidavit as contained herein, show his authority to bind the corporation.

By: _____

Title: _____

(Contractor's corporate seal)

(Affix Surety's corporate seal)

Surety

By: _____

_____, 20__

Countersigned:

Florida Resident Agent

Florida License Number

(Attach "BOND AFFIDAVIT" on copy of form bound in these specifications)

END OF PERFORMANCE BOND

CHARLOTTE COUNTY AIRPORT AUTHORITY

BOND AFFIDAVIT

State of _____

County of _____

Before me, the undersigned authority, personally appeared _____, who, being duly sworn, deposes and says that he is a duly authorized (resident) (nonresident) insurance agent, properly licensed under the laws of the State of _____ and the State of Florida, to represent _____ of (company name), a company authorized to make corporate surety bonds under the laws of the State of Florida.

Said _____ further certifies that as Attorney-in-fact for the said _____ he has signed the attached bond in the sum of U.S. \$_____ on behalf of _____ covering **Charlotte County Airport Authority, FDOT FM No. TBD, for the SOUTH TERMINAL EXPANSION AND IN-LINE BAGGAGE SYSTEM at Punta Gorda Airport, Punta Gorda, Florida.**

Said _____ further certifies that the premium on the said bond is _____ which will be paid in full direct to him as Attorney-in-fact, and included in his regular accounts to the said _____, and that he will receive his regular commission of _____ percent as Attorney-in-fact for the execution of said Bond and that his commission will not be divided with anyone except as follows: _____ percent to _____ (company name), who is duly authorized resident insurance agent and properly licensed under the laws of the State of Florida.

Countersigned:

Florida Resident Agent

Agent and Attorney-in-Fact

Florida License Number

ACKNOWLEDGMENT FOR ATTORNEY-IN-FACT

Sworn to and subscribed before me

this __ day of _____, 20__.

Notary Public, State of _____

My Commission expires _____.

END OF BOND AFFIDAVIT

GENERAL PROVISIONS

ITEM C-105 MOBILIZATION

105-1 Description. This item of work shall consist of, but is not limited to, work and operations necessary for the movement of personnel, equipment, material and supplies to and from the project site for work on the project except as provided in the contract as separate pay items.

105-2 Mobilization limit. Mobilization shall be limited to **10** percent of the total project cost. It shall also include work required for submittals, final design of the pre-manufactured building, and permitting of the building.

105-3 Posted notices. Prior to commencement of construction activities, the Contractor must post the following documents in a prominent and accessible place where they may be easily viewed by all employees of the prime Contractor and by all employees of subcontractors engaged by the prime Contractor: Equal Employment Opportunity (EEO) Poster “Equal Employment Opportunity is the Law” in accordance with the Office of Federal Contract Compliance Programs Executive Order 11246, as amended; Davis Bacon Wage Poster (WH 1321) - DOL “Notice to All Employees” Poster; and Applicable Davis-Bacon Wage Rate Determination. These notices must remain posted until final acceptance of the work by the Owner.

105-4 Engineer/RPR field office. ~~The Contractor shall provide dedicated space for the use of the field RPR and inspectors, as a field office for the duration of the project. This space shall be located conveniently near the construction and shall be separate from any space used by the Contractor. The Contractor shall furnish water, sanitary facilities, heat, air conditioning, and electricity in accordance with local building codes. An~~ **Engineer/RPR field office is not required.**

METHOD OF MEASUREMENT

105-5 Basis of measurement and payment. Based upon the contract lump sum price for “Mobilization” partial payments will be allowed as follows:

- a. With first pay request, 25%.
- b. When 25% or more of the original contract is earned, an additional 25%.
- c. When 50% or more of the original contract is earned, an additional 40%.

d. After Final Inspection, Staging area clean-up and delivery of all Project Closeout materials as required by Section 90, paragraph 90-11, *Contractor Final Project Documentation*, the final 10%.

BASIS OF PAYMENT

105-6 Payment will be made under:

Item C-105-2.1 Mobilization - per lump sum

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.

Office of Federal Contract Compliance Programs (OFCCP)

Executive Order 11246, as amended

EEOC-P/E-1 – Equal Employment Opportunity is the Law Poster

United States Department of Labor, Wage and Hour Division (WHD)

WH 1321 – Employee Rights under the Davis-Bacon Act Poster

END OF ITEM C-105

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SECTION 10 DEFINITION OF TERMS

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

Paragraph Number	Term	Definition
10-01	AASHTO	The American Association of State Highway and Transportation Officials.
10-02	Access Road	The right-of-way, the roadway and all improvements constructed thereon connecting the airport to a public roadway.
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	Airport	Airport means an area of land or water which is used or intended to be used for the landing and takeoff of aircraft; an appurtenant area used or intended to be used for airport buildings or other airport facilities or rights of way; airport buildings and facilities located in any of these areas, and a heliport.
10-05	Airport Improvement Program (AIP)	A grant-in-aid program, administered by the Federal Aviation Administration (FAA).
10-06	Air Operations Area (AOA)	The term air operations area (AOA) 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.
10-07	Apron	Area where aircraft are parked, unloaded or loaded, fueled and/or serviced.
10-08	ASTM International (ASTM)	Formerly known as the American Society for Testing and Materials (ASTM).
10-09	Award	The Owner's notice to the successful bidder of the acceptance of the submitted bid.
10-10	Bidder	Any individual, partnership, firm, or corporation, acting directly or through a duly authorized representative, who submits a proposal for the work contemplated.
10-11	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.
10-12	Calendar Day	Every day shown on the calendar.
10-13	Certificate of Analysis (COA)	The COA is the manufacturer's Certificate of Compliance (COC) including all applicable test results required by the specifications.

Paragraph Number	Term	Definition
10-14	Certificate of Compliance (COC)	The manufacturer's certification stating that materials or assemblies furnished fully comply with the requirements of the contract. The certificate shall be signed by the manufacturer's authorized representative.
10-15	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 work within the scope of the contract and necessary to complete the project.
10-16	Contract	A written agreement between the Owner and the Contractor that establishes the obligations of the parties including but not limited to performance of work, furnishing of labor, equipment and materials and the basis of payment. The awarded contract includes but may not be limited to: Advertisement, Contract form, Proposal, Performance bond, payment bond, General provisions, certifications and representations, Technical Specifications, Plans, Supplemental Provisions, standards incorporated by reference and issued addenda.
10-17	Contract Item (Pay Item)	A specific unit of work for which a price is provided in the contract.
10-18	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.
10-19	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.
10-20	Contractors Quality Control (QC) Facilities	The Contractor's QC facilities in accordance with the Contractor Quality Control Program (CQCP).
10-21	Contractor Quality Control Program (CQCP)	Details the methods and procedures that will be taken to assure that all materials and completed construction required by the contract conform to contract plans, technical specifications and other requirements, whether manufactured by the Contractor, or procured from subcontractors or vendors.
10-22	Control Strip	A demonstration by the Contractor that the materials, equipment, and construction processes results in a product meeting the requirements of the specification.
10-23	Construction Safety and Phasing Plan (CSPP)	The overall plan for safety and phasing of a construction project developed by the airport operator, or developed by the airport

Paragraph Number	Term	Definition
		operator's consultant and approved by the airport operator. It is included in the invitation for bids and becomes part of the project specifications.
10-24	Drainage System	The system of pipes, ditches, and structures by which surface or subsurface waters are collected and conducted from the airport area.
10-25	Engineer	The individual, partnership, firm, or corporation duly authorized by the Owner to be responsible for engineering, inspection, and/or observation of the contract work and acting directly or through an authorized representative.
10-26	Equipment	All machinery, together with the necessary supplies for upkeep and maintenance; and all tools and apparatus necessary for the proper construction and acceptable completion of the work.
10-27	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 Owner's Engineer or Resident Project Representative (RPR) to be necessary to complete the work within the intended scope of the contract as previously modified.
10-28	FAA	The Federal Aviation Administration. When used to designate a person, FAA shall mean the Administrator or their duly authorized representative.
10-29	Federal Specifications	The federal specifications and standards, commercial item descriptions, and supplements, amendments, and indices prepared and issued by the General Services Administration.
10-30	Force Account	a. Contract Force Account - A method of payment that addresses extra work performed by the Contractor on a time and material basis. b. Owner Force Account - Work performed for the project by the Owner's employees.
10-31	Intention of Terms	Whenever, in these specifications or on the plans, the words "directed," "required," "permitted," "ordered," "designated," "prescribed," or words of like import are used, it shall be understood that the direction, requirement, permission, order, designation, or prescription of the Engineer and/or Resident Project Representative (RPR) 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 and/or RPR, 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

Paragraph Number	Term	Definition
		specific reference.
10-32	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.
10-33	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% of the total amount of the award contract. All other items shall be considered minor contract items.
10-34	Materials	Any substance specified for use in the construction of the contract work.
10-35	Modification of Standards (MOS)	Any deviation from standard specifications applicable to material and construction methods in accordance with FAA Order 5300.1.
10-36	Notice to Proceed (NTP)	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.
10-37	Owner	The term "Owner" shall mean the party of the first part or the contracting agency signatory to the contract. Where the term "Owner" is capitalized in this document, it shall mean airport Sponsor only. The Owner for this project is <u>Charlotte County Airport Authority</u> .
10-38	Passenger Facility Charge (PFC)	Per 14 Code of Federal Regulations (CFR) Part 158 and 49 United States Code (USC) § 40117, a PFC is a charge imposed by a public agency on passengers enplaned at a commercial service airport it controls.
10-39	Pavement Structure	The combined surface course, base course(s), and subbase course(s), if any, considered as a single unit.
10-40	Payment bond	The approved form of security furnished by the Contractor and their own surety as a guaranty that the Contractor will pay in full all bills and accounts for materials and labor used in the construction of the work.
10-41	Performance bond	The approved form of security furnished by the Contractor and their own surety as a guaranty that the Contractor will complete the work in accordance with the terms of the contract.
10-42	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. Plans may also be referred to as 'contract drawings.'

Paragraph Number	Term	Definition
10-43	Project	The agreed scope of work for accomplishing specific airport development with respect to a particular airport.
10-44	Proposal	The written offer of the bidder (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.
10-45	Proposal guaranty	The security furnished with a proposal to guarantee that the bidder will enter into a contract if their own proposal is accepted by the Owner.
10-46	Quality Assurance (QA)	Owner's responsibility to assure that construction work completed complies with specifications for payment.
10-47	Quality Control (QC)	Contractor's responsibility to control material(s) and construction processes to complete construction in accordance with project specifications.
10-48	Quality Assurance (QA) Inspector	An authorized representative of the Engineer and/or Resident Project Representative (RPR) assigned to make all necessary inspections, observations, tests, and/or observation of tests of the work performed or being performed, or of the materials furnished or being furnished by the Contractor.
10-49	Quality Assurance (QA) Laboratory	The official quality assurance testing laboratories of the Owner or such other laboratories as may be designated by the Engineer or RPR. May also be referred to as Engineer's, Owner's, or QA Laboratory.
10-50	Resident Project Representative (RPR)	The individual, partnership, firm, or corporation duly authorized by the Owner to be responsible for all necessary inspections, observations, tests, and/or observations of tests of the contract work performed or being performed, or of the materials furnished or being furnished by the Contractor, and acting directly or through an authorized representative.
10-51	Runway	The area on the airport prepared for the landing and takeoff of aircraft.
10-52	Runway Safety Area (RSA)	A defined surface surrounding the runway prepared or suitable for reducing the risk of damage to aircraft. See the construction safety and phasing plan (CSPP) for limits of the RSA.
10-53	Safety Plan Compliance Document (SPCD)	Details how the Contractor will comply with the CSPP.
10-54	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

Paragraph Number	Term	Definition
		if included in the contract physically.
10-55	Sponsor	A Sponsor is defined in 49 USC § 47102(24) as a public agency that submits to the FAA for an AIP grant; or a private Owner of a public-use airport that submits to the FAA an application for an AIP grant for the airport.
10-56	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; navigational aids; buildings; vaults; and, other manmade features of the airport that may be encountered in the work and not otherwise classified herein.
10-57	Subgrade	The soil that forms the pavement foundation.
10-58	Superintendent	The Contractor's executive representative who is present on the work during progress, authorized to receive and fulfill instructions from the RPR, and who shall supervise and direct the construction.
10-59	Supplemental Agreement	A written agreement between the Contractor and the Owner that establishes the basis of payment and contract time adjustment, if any, for the work affected by the supplemental agreement. A supplemental agreement is required if: (1) in scope work would increase or decrease the total amount of the awarded contract by more than 25%; (2) in scope work would increase or decrease the total of any major contract item by more than 25%; (3) work that is not within the scope of the originally awarded contract; or (4) adding or deleting of a major contract item.
10-60	Surety	The corporation, partnership, or individual, other than the Contractor, executing payment or performance bonds that are furnished to the Owner by the Contractor.
10-61	Taxilane	A taxiway designed for low speed movement of aircraft between aircraft parking areas and terminal areas.
10-62	Taxiway	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, aircraft parking areas, and terminal areas.
10-63	Taxiway/Taxilane Safety Area (TSA)	A defined surface alongside the taxiway prepared or suitable for reducing the risk of damage to an aircraft. See the construction safety and phasing plan (CSPP) for limits of the TSA.
10-64	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.
10-65	Working day	A working day shall be any day other than a legal holiday,

Paragraph Number	Term	Definition
		Saturday, or Sunday on which the normal working forces of the Contractor may proceed with regular work for at least six (6) hours toward completion of the contract. When work is suspended for causes beyond the Contractor's control, it will not be counted as a working day. Saturdays, Sundays and holidays on which the Contractor's forces engage in regular work will be considered as working days.
10-66	Owner Defined terms	None

END OF SECTION 10

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SECTION 20 PROPOSAL REQUIREMENTS AND CONDITIONS

20-01 Advertisement for Bid Solicitation. Page 1

20-02 Qualification of bidders. Each bidder shall submit evidence of competency and evidence of financial responsibility to perform the work to the Owner at the time of bid opening.

Evidence of competency, unless otherwise specified, shall consist of statements covering the bidder's past experience on similar work, and a list of equipment and a list of key personnel that would be available for the work.

Each bidder shall furnish the Owner satisfactory evidence of their financial responsibility. Evidence of financial responsibility, unless otherwise specified, shall consist of a confidential statement or report of the bidder's financial resources and liabilities as of the last calendar year or the bidder'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 bidder shall further certify whether their financial responsibility is approximately the same as stated or reported by the public accountant. If the bidder's financial responsibility has changed, the bidder shall qualify the public accountant's statement or report to reflect the bidder's true financial condition at the time such qualified statement or report is submitted to the Owner.

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

20-03 Contents of proposal forms. The Owner's proposal forms state the location and description of the proposed construction; the place, date, and time of opening of the proposals; and the estimated quantities of the various items of work to be performed and materials to be furnished for which unit bid prices are asked. The proposal form states the time in which the work must be completed, and the amount of the proposal guaranty that must accompany the proposal. The Owner will accept only those Proposals properly executed on physical forms or electronic forms provided by the Owner. Bidder actions that may cause the Owner to deem a proposal irregular are given in paragraph 20-09 *Irregular proposals*.

Mobilization is limited to **10** percent of the total project cost.

~~{ A prebid conference is required on this project to discuss as a minimum, the following items: material requirements; submittals; Quality Control/Quality Assurance requirements; the construction safety and phasing plan including airport access and staging areas; and unique airfield paving construction requirements. { Insert the time, date, and place of the meeting. } }~~

20-04 Issuance of proposal forms. The Owner reserves the right to refuse to issue a proposal form to a prospective bidder if the bidder is 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 bidding.
- 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 bidder.
- c. Documented record of Contractor default under previous contracts with the Owner.
- d. Documented record of 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 bidder 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 provided in the Section 40, paragraph 40-02, Alteration of Work and Quantities, without in any way invalidating the unit bid prices.

20-06 Examination of plans, specifications, and site. The bidder is expected to carefully examine the site of the proposed work, the proposal, plans, specifications, and contract forms. Bidders shall satisfy themselves to the character, quality, and quantities of work to be performed, materials to be furnished, and to the requirements of the proposed contract. The submission of a proposal shall be prima facie evidence that the bidder has made such examination and is satisfied to the conditions to be encountered in performing the work and the requirements of the proposed contract, plans, and specifications.

Boring logs and other records of subsurface investigations and tests are available for inspection of bidders. It is understood and agreed that such subsurface information, whether included in the plans, specifications, or otherwise made available to the bidder, 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 bidders. It is further understood and agreed that each bidder is solely responsible for all assumptions, deductions, or conclusions which the bidder may make or obtain from their own 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 bidder shall submit their proposal on the forms furnished by the Owner. All blank spaces in the proposal forms, unless explicitly stated otherwise, must be correctly filled in where indicated for each and every item for which a quantity is given. The bidder shall state the price (written in ink or typed) both in words and numerals which they propose for each pay item furnished in the proposal. In case of conflict between words and numerals, the words, unless obviously incorrect, shall govern.

The bidder shall correctly sign the proposal in ink. If the proposal is made by an individual, their 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 where 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 their authority to do so and that the signature is binding upon the firm or corporation.

20-08 Responsive and responsible bidder. A responsive bid conforms to all significant terms and conditions contained in the Owner's invitation for bid. It is the Owner's responsibility to decide if the exceptions taken by a bidder to the solicitation are material or not and the extent of deviation it is willing to accept.

A responsible bidder has the ability to perform successfully under the terms and conditions of a proposed procurement, as defined in 2 CFR § 200.318(h). This includes such matters as Contractor integrity, compliance with public policy, record of past performance, and financial and technical resources.

20-09 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 that 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 bidder 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.
- f. If the applicable Disadvantaged Business Enterprise information is incomplete.

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.

20-10 Bid guarantee. Each separate proposal shall be accompanied by a bid bond, certified check, or other specified acceptable collateral, in the amount specified in the proposal form. Such bond, check, or collateral, shall be made payable to the Owner.

20-11 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 bidder 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 or as modified by Addendum before the time specified for opening all bids. Proposals received after the bid opening time shall be returned to the bidder unopened.

20-12 Withdrawal or revision of proposals. A bidder may withdraw or revise (by withdrawal of one proposal and submission of another) a proposal provided that the bidder's request for withdrawal is received by the Owner in writing ~~[- by fax -] [- by email -]~~ 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.

20-13 Public opening of proposals. Proposals shall be opened, and read, publicly at the time and place specified in the advertisement. Bidders, 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 bidder unopened.

20-14 Disqualification of bidders. A bidder 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 bidders. Bidders participating in such collusion shall be disqualified as bidders for any future work of the Owner until any such participating bidder has been reinstated by the Owner as a qualified bidder.

c. If the bidder is considered to be in "default" for any reason specified in paragraph 20-04, *Issuance of Proposal Forms*, of this section.

20-15 Discrepancies and Omissions. A Bidder who discovers discrepancies or omissions with the project bid documents shall immediately notify the Owner's Engineer of the matter. A bidder that has doubt as to the true meaning of a project requirement may submit to the Owner's Engineer a written request for interpretation no later than **10** days prior to bid opening.

Any interpretation of the project bid documents by the Owner's Engineer will be by written addendum issued by the Owner. The Owner will not consider any instructions, clarifications or interpretations of the bidding documents in any manner other than written addendum.

END OF SECTION 20

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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 bidder's proposal contains a discrepancy between unit bid prices written in words and unit bid prices written in numbers, the unit bid price written in words shall govern.

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

- a. If the proposal is irregular as specified in Section 20, paragraph 20-09, *Irregular Proposals*.
- b. If the bidder is disqualified for any of the reasons specified Section 20, paragraph 20-14, *Disqualification of Bidders*.

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.

If the Owner elects to proceed with an award of contract, the Owner will make award to the responsible bidder whose bid, conforming with all the material terms and conditions of the bid documents, is the lowest in price.

30-03 Cancellation of award. The Owner reserves the right to cancel the award without liability to the bidder, 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 paragraph 30-07 *Approval of Contract*.

30-04 Return of proposal guaranty. All proposal guaranties, except those of the two lowest bidders, will be returned immediately after the Owner has made a comparison of bids as specified in the paragraph 30-01, *Consideration of Proposals*. Proposal guaranties of the two lowest bidders will be retained by the Owner until such time as an award is made, at which time, the unsuccessful bidder's proposal guaranty will be returned. The successful bidder's proposal guaranty will be returned as soon as the Owner receives the contract bonds as specified in paragraph 30-05, *Requirements of Contract Bonds*.

30-05 Requirements of contract bonds. At the time of the execution of the contract, the successful bidder shall furnish the Owner a surety bond or bonds that have been fully executed by the bidder 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 bidder shall sign (execute) the necessary agreements for entering into the contract and return the signed contract to the Owner, along with the fully executed surety bond or bonds specified in paragraph 30-05, *Requirements of Contract Bonds*, of this section, within **15** calendar days from the date mailed or otherwise delivered to the successful bidder.

30-07 Approval of contract. Upon receipt of the contract and contract bond or bonds that have been executed by the successful bidder, 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 bidder's proposal and the terms of the contract.

30-08 Failure to execute contract. Failure of the successful bidder to execute the contract and furnish an acceptable surety bond or bonds within the period specified in paragraph 30-06, *Execution of Contract*, of this section shall be just cause for cancellation of the award and forfeiture of the proposal guaranty, not as a penalty, but as liquidated damages to the Owner.

END OF SECTION 30

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 the right to make such changes in quantities and work as may be necessary or desirable to complete, in a satisfactory manner, the original intended work. Unless otherwise specified in the Contract, the Owner's Engineer or RPR shall be and is hereby authorized to make, in writing, such in-scope alterations in the work and variation of quantities as may be necessary to complete the work, provided such action does not represent a significant change in the character of the work.

For purpose of this section, a significant change in character of work means: any change that is outside the current contract scope of work; any change (increase or decrease) in the total contract cost by more than 25%; or any change in the total cost of a major contract item by more than 25%.

Work alterations and quantity variances that do not meet the definition of significant change in character of work shall not invalidate the contract nor release the surety. Contractor agrees to accept payment for such work alterations and quantity variances in accordance with Section 90, paragraph 90-03, *Compensation for Altered Quantities*.

Should the value of altered work or quantity variance meet the criteria for significant change in character of work, such altered work and quantity variance shall be covered by a supplemental agreement. Supplemental agreements shall also require consent of the Contractor's surety and separate performance and payment bonds. 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.

40-03 Omitted items. The Owner, the Owner's Engineer or the RPR may provide written notice to the Contractor to omit from the work any contract item that does not meet the definition of major contract item. 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 Section 90, paragraph 90-04, *Payment for Omitted Items*.

40-04 Extra work. Should acceptable completion of the contract require the Contractor to perform an item of work not provided for in the awarded contract as previously modified by change order or supplemental agreement, Owner may issue a Change Order to cover the necessary extra work. Change orders for 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 RPR's opinion, is necessary for completion of the extra work.

When determined by the RPR to be in the Owner's best interest, the RPR may order the Contractor to proceed with extra work as provided in Section 90, paragraph 90-05, *Payment for Extra Work*. 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 defined in Section 10, paragraph 10-59, *Supplemental Agreement*.

If extra work is essential to maintaining the project critical path, RPR may order the Contractor to commence the extra work under a Time and Material contract method. Once sufficient detail is available to establish the level of effort necessary for the extra work, the Owner shall initiate a change order or supplemental agreement to cover the extra work.

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. The Contractor shall maintain traffic in the manner detailed in the Construction Safety and Phasing Plan (CSPP).

a. It is understood and agreed that the Contractor shall provide for the free and unobstructed movement of aircraft in the air operations areas (AOAs) of the airport with respect to their own operations and the operations of all subcontractors as specified in Section 80, paragraph 80-04, *Limitation of Operations*. 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 Section 70, paragraph 70-15, *Contractor's Responsibility for Utility Service and Facilities of Others*.

b. With respect to their own operations and the operations of all 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 in accordance with the construction safety and phasing plan (CSPP) and the safety plan compliance document (SPCD). Refer to AC 150/5210-5, *Painting, Marking and Lighting of Vehicles Used on an Airport* and AC 150/5370-2, *Operational Safety on Airports During Construction* for applicable standards.

c. When the contract requires the maintenance of 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 the road, street, or highway open to all traffic and shall provide maintenance as may be required to accommodate traffic. The Contractor, at their expense, shall be responsible for the repair to equal or better than preconstruction conditions of any damage caused by the Contractor's equipment and personnel. The Contractor shall furnish, erect, and maintain barricades, warning signs, flag person, and other traffic control devices in reasonable conformity with the Manual on Uniform Traffic Control Devices (MUTCD) (<http://mutcd.fhwa.dot.gov/>), unless otherwise specified. 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.

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 Resident Project Representative (RPR) shall be notified prior to disturbing such structure. The disposition of existing structures so encountered shall be immediately determined by the RPR in accordance with the provisions of the contract.

Except as provided in Section 40, paragraph 40-07, *Rights in and Use of Materials Found in the Work*, 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 used in the work as otherwise provided for in the contract and shall remain the property of the Owner when so used 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 embankment, the Contractor may at their own option either:

a. Use such material in another contract item, providing such use is approved by the RPR 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 RPR; or

c. Use such material for the Contractor's 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., the Contractor shall request the RPR's approval in advance of such use.

Should the RPR 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 their 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 use of such material used in the work or removed from the site.

Should the RPR 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 their own 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 cleanup. 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. The Contractor 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 the property Owner.

END OF SECTION 40

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SECTION 50 CONTROL OF WORK

50-01 Authority of the Resident Project Representative (RPR). The RPR has final authority regarding the interpretation of project specification requirements. The RPR shall determine acceptability of the quality of materials furnished, method of performance of work performed, and the manner and rate of performance of the work. The RPR does not have the authority to accept work that does not conform to specification requirements.

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 RPR 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 their opinion, result in a finished product having a level of safety, economy, durability, and workmanship acceptable to the Owner, the RPR will advise the Owner of their determination that the affected work be accepted and remain in place. The RPR will document the determination and recommend to the Owner a basis of acceptance that will provide for an adjustment in the contract price for the affected portion of the work. Changes in the contract price must be covered by contract change order or supplemental agreement as applicable.

If the RPR 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 RPR's written orders.

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 RPR's responsibility to insist on strict compliance with the requirements of the contract, plans, and specifications during the Contractor's execution of the work, when, in the RPR's opinion, such compliance is essential to provide an acceptable finished portion of the work.

The term "reasonably close conformity" is also intended to provide the RPR with the authority, after consultation with the Sponsor and FAA, to use sound engineering judgment in their determinations to accept work that is not in strict conformity, but will provide a finished product equal to or better than that required by the requirements of the contract, plans and specifications.

The RPR will not be responsible for the Contractor's means, methods, techniques, sequences, or procedures of construction or the safety precautions incident thereto.

50-03 Coordination of contract, plans, and specifications. The contract, plans, specifications, and all referenced standards cited are essential parts of the contract requirements. If electronic files are provided and used on the project and there is a conflict between the electronic files and hard copy plans, the hard copy plans shall govern. 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 advisory circulars (ACs); contract general provisions shall govern over plans, cited standards for materials or testing, and cited ACs; plans shall govern over cited standards for materials or testing and cited ACs. If any paragraphs contained in the Special Provisions conflict with General Provisions or Technical Specifications, the Special Provisions shall govern.

From time to time, discrepancies within cited testing standards occur due to the timing of the change, edits, and/or replacement of the standards. If the Contractor discovers any apparent discrepancy within standard test methods, the Contractor shall immediately ask the RPR for an interpretation and decision, and such decision shall be final.

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, Contractor shall immediately notify the Owner or the designated representative in writing requesting their written interpretation and decision.

50-04 List of Special Provisions.

No. 1: Construction Safety Plan and Security Requirements,

No. 2: Construction Time and Liquidated Damages,

No. 3: Airport Project Procedures,

No. 4: Protection of Airport, Cables, Controls, NAVAIDS and Weather Bureau Facilities

50-05 Cooperation of Contractor. The Contractor shall be supplied with **two** hard copies or an electronic PDF of the plans and specifications. The Contractor shall have available on the construction site at all times one hardcopy each of the plans and specifications. Additional hard 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 shall cooperate with the RPR and their inspectors and with other Contractors in every way possible. The Contractor shall have a competent superintendent on the work at all times who is fully authorized as their 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 RPR or their authorized representative.

50-06 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 the work 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 their own contract and shall protect and hold harmless the Owner from any and all damages or claims that may arise because of inconvenience, delays, or loss experienced because of the presence and operations of other Contractors working within the limits of the same project.

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

50-07 Construction layout and stakes. The Engineer/RPR shall establish necessary horizontal and vertical control. The establishment of Survey Control and/or reestablishment of survey control shall be by a State Licensed Land Surveyor. Contractor is responsible for preserving integrity of horizontal and vertical controls established by Engineer/RPR. In case of negligence on the part of the Contractor or their employees, resulting in the destruction of any horizontal and vertical control, the resulting costs will be deducted as a liquidated damage against the Contractor.

Prior to the start of construction, the Contractor will check all control points for horizontal and vertical accuracy and certify in writing to the RPR that the Contractor concurs with survey control established for the project. All lines, grades and measurements from control points necessary for the proper execution and control of the work on this project will be provided to the RPR. The Contractor is responsible to establish all layout required for the construction of the project.

Copies of survey notes will be provided to the RPR for each area of construction and for each placement of material as specified to allow the RPR to make periodic checks for conformance with plan grades, alignments and grade tolerances required by the applicable material specifications. Surveys will be provided to the RPR prior to commencing work items that cover or disturb the survey staking. Survey(s) and notes shall be provided in the following format(s): **Electronic files Autocad/Civil 3D, ASCII or Text files, and copies of field book.**

Laser, GPS, String line, or other automatic control shall be checked with temporary control as necessary. In the case of error, on the part of the Contractor, their surveyor, employees or subcontractors, resulting in established grades, alignment or grade tolerances that do not concur with those specified or shown on the plans, the Contractor is solely responsible for correction, removal, replacement and all associated costs at no additional cost to the Owner.

No direct payment will be made, unless otherwise specified in contract documents, for this labor, materials, or other expenses. The cost shall be included in the price of the bid for the various items of the Contract.

50-08 Authority and duties of Quality Assurance (QA) inspectors. QA inspectors shall be authorized to inspect all work done and all material furnished. Such QA inspection may extend to all or any part of the work and to the preparation, fabrication, or manufacture of the materials to be used. QA inspectors are not authorized to revoke,

alter, or waive any provision of the contract. QA inspectors are not authorized to issue instructions contrary to the plans and specifications or to act as foreman for the Contractor.

QA Inspectors are authorized to notify the Contractor or their 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 RPR for a decision.

50-09 Inspection of the work. All materials and each part or detail of the work shall be subject to inspection. The RPR 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 RPR 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.

Provide advance written notice to the RPR of work the Contractor plans to perform each week and each day. Any work done or materials used without written notice and allowing opportunity for inspection by the RPR may be ordered removed and replaced at the Contractor's expense.

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 that does not conform to the requirements of the contract, plans, and specifications will be considered unacceptable, unless otherwise determined acceptable by the RPR as provided in paragraph 50-02, *Conformity with Plans and Specifications*.

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 Section 70, paragraph 70-14, *Contractor's Responsibility for Work*.

No removal work made under provision of this paragraph shall be done without lines and grades having been established by the RPR. Work done contrary to the instructions of the RPR, work done beyond the lines shown on the plans or as established by the RPR, 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 with any order of the RPR made under the provisions of this subsection, the RPR will have authority to cause unacceptable work to be remedied or removed and replaced; and unauthorized work to be removed and recover the resulting costs as a liquidated damage against 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 that 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, at their own expense, shall be responsible for the repair to equal or better than preconstruction conditions of any damage caused by the Contractor's equipment and personnel. The Contractor must check to see if the on-site project access roads and haul routes will support the construction equipment. Particular attention should be paid when sections of existing airfield pavements will be used as haul routes to assure that existing pavements are not overloaded. The Contractor shall preserve or rehabilitate any access roads or haul routes to its initial conditions. Videotape or photographs shall be required to document existing conditions prior to start of construction. Construction traffic should be kept off airport pavements to the extent possible.

50-12 Maintenance during construction. The Contractor shall maintain the work during construction and until the work is accepted. 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 paragraph 50-12, *Maintenance during Construction*, the RPR 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 RPR's notification, the Owner 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 recovered as a liquidated damage against the Contractor.

50-14 Partial acceptance. If at any time during the execution of the project the Contractor substantially completes a usable unit or portion of the work, the occupancy of which will benefit the Owner, the Contractor may request the RPR to make final inspection of that unit. If the RPR finds upon inspection that the unit has been satisfactorily completed in compliance with the contract, the RPR may accept it as being complete, 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 RPR and Owner will make an inspection. If all construction provided for and contemplated by the contract is found to be complete in accordance with the contract, plans, and specifications, such inspection shall constitute the final inspection. The RPR 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 RPR will notify the Contractor and the Contractor shall correct the unsatisfactory work. 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 RPR 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 for work or materials not clearly provided for in the contract, plans, or specifications or previously authorized as extra work, the Contractor shall notify the RPR in writing of their intention to claim such additional compensation before the Contractor begins the work on which the Contractor bases the claim. If such notification is not given or the RPR 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 RPR 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 a written claim to the RPR 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.

~~The provisions of this paragraph will apply only to contracts awarded to the lowest bidder pursuant to competitive bidding.~~

~~On projects with original contract amounts in excess of \$100,000, the Contractor may submit to the RPR, 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 value engineering cost 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 value engineering cost 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.~~

~~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 value engineering cost proposal not accepted by the RPR, within the period specified in the proposal. The provisions of this subsection shall not be construed to require the RPR to consider any value engineering cost proposal that 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 value engineering cost proposal has been issued. If a change order has not been issued by the date upon which the Contractor's value engineering cost proposal specifies that a decision should be made, or such other date as the Contractor may subsequently have requested in writing, such value engineering cost proposal shall be deemed rejected.~~

~~The RPR shall be the sole judge of the acceptability of a value engineering cost 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 RPR may disregard the contract bid prices if, in the RPR'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 value engineering cost 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 value engineering cost proposal from amounts payable to the Contractor under the contract.~~

~~If the Contractor's value engineering cost proposal is accepted in whole or in part, such acceptance will be by a contract change order that shall specifically state that it is executed pursuant to this paragraph. Such change order shall incorporate the changes in the plans and specifications which are necessary to permit the value engineering cost proposal or such part of it as has been accepted and shall include any conditions upon which the RPR's approval is based. The change order shall also set forth the estimated net savings attributable to the value engineering cost 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% share of the net savings shall constitute full compensation to the Contractor for the value engineering cost proposal and the performance of the work.~~

~~Acceptance of the value engineering cost proposal and performance of the work shall not extend the time of completion of the contract unless specifically provided for in the contract change order. }~~

END OF SECTION 50

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SECTION 60 CONTROL OF MATERIALS

60-01 Source of supply and quality requirements. The materials used in 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 documentation to the RPR as to the origin, composition, and manufacture of all materials to be used in the work. Documentation shall be furnished promptly after execution of the contract but, in all cases, prior to delivery of such materials.

At the RPR's option, materials may be approved at the source of supply before delivery. 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 meets the requirements of the specifications; and is listed in AC 150/5345-53, *Airport Lighting Equipment Certification Program* and *Addendum*, that is in effect on the date of advertisement.

60-02 Samples, tests, and cited specifications. All materials used in the work shall be inspected, tested, and approved by the RPR before incorporation in the work unless otherwise designated. Any work in which untested materials are used without approval or written permission of the RPR 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 RPR, shall be removed at the Contractor's expense.

Unless otherwise designated, quality assurance tests will be made by and at the expense of the Owner in accordance with the cited standard methods of ASTM, American Association of State Highway and Transportation Officials (AASHTO), federal specifications, Commercial Item Descriptions, and all other cited methods, which are current on the date of advertisement for bids.

The testing organizations performing on-site quality assurance field tests shall have copies of all referenced standards on the construction site for use by all technicians and other personnel. Unless otherwise designated, samples for quality assurance will be taken by a qualified representative of the RPR. 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 their request after review and approval of the RPR.

A copy of all Contractor QC test data shall be provided to the RPR 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 RPR showing all test data reports, plus an analysis of all results showing ranges, averages, and corrective action taken on all failing tests.

The Contractor shall employ a Quality Control (QC) testing organization to perform all Contractor required QC tests in accordance with Item C-100 Contractor Quality Control Program (CQCP).

60-03 Certification of compliance/analysis (COC/COA). The RPR may permit the use, prior to sampling and testing, of certain materials or assemblies when accompanied by manufacturer's COC 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. The COA is the manufacturer's COC and includes all applicable test results.

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 RPR.

When a material or assembly is specified by "brand name or equal" and the Contractor elects to furnish the specified "or equal," 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.

The RPR shall be the sole judge as to whether the proposed “or equal” is suitable for use in the work.

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

60-04 Plant inspection. The RPR or their 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 acceptance of the material or assembly.

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

a. The RPR shall have the cooperation and assistance of the Contractor and the producer with whom the Contractor has contracted for materials.

b. The RPR 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 RPR, the Contractor shall arrange for adequate office or working space that may be reasonably needed for conducting plant inspections. Place office or working space in a convenient location with respect to the plant.

It is understood and agreed that the Owner shall have the right to retest any material that has been tested and approved at the source of supply after it has been delivered to the site. The RPR 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/ Resident Project Representative (RPR) field office. ~~—The Contractor shall provide dedicated space for the use of the engineer, RPR, and inspectors, as a field office for the duration of the project. This space shall be located conveniently near the construction and shall be separate from any space used by the Contractor. The Contractor shall furnish water, sanitary facilities, heat, air conditioning, and electricity.~~] An Engineer/RPR field office is not required.

60-06 Storage of materials. Materials shall be stored 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 to facilitate their prompt inspection. The Contractor shall coordinate the storage of all materials with the RPR. 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 RPR. 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 RPR 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 their 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 RPR.

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 RPR has approved its use in the work.

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

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 that 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

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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. The Contractor 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 their 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 the Contractor or the Contractor's 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 execution 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, the Contractor shall provide for such use by suitable legal agreement with the Patentee or Owner. The Contractor and the surety shall indemnify and hold 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 execution 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) must be shown on the plans and 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 RPR.

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 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 RPR, 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 Participation.** The United States Government has agreed to reimburse the Owner for some portion of the contract costs. The contract work is subject to the inspection and approval of duly authorized representatives of the FAA Administrator. No requirement of this contract shall be construed as making the United States 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's worksite and facilities shall comply with applicable federal, state, and local requirements for health, safety and sanitary provisions.

70-07 Public convenience and safety. The Contractor shall control their operations and those of their 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 their own operations and those of their own subcontractors and all suppliers in accordance with Section 40, paragraph 40-05, *Maintenance of Traffic*, and shall limit such operations for the convenience and safety of the traveling public as specified in Section 80, paragraph 80-04, *Limitation of Operations*.

The Contractor shall remove or control debris and rubbish resulting from its work operations at frequent intervals, and upon the order of the RPR. If the RPR determines the existence of Contractor debris in the work site represents a hazard to airport operations and the Contractor is unable to respond in a prompt and reasonable manner, the RPR

reserves the right to assign the task of debris removal to a third party and recover the resulting costs as a liquidated damage against the Contractor.

70-08 Construction Safety and Phasing Plan (CSPP). ~~The Contractor shall complete the work in accordance with the approved Construction Safety and Phasing Plan (CSPP) developed in accordance with AC 150/5370-2, Operational Safety on Airports During Construction. The CSPP is on sheet(s) [] of the project plans.~~

70-09 Use of explosives. ~~The use of explosives is not permitted on this project. When the use of explosives is necessary for the execution 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 RPR 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 their 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/RPR 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 execution of the work, resulting from any act, omission, neglect, or misconduct in manner or method of executing the work, or at any time due to defective work or materials, and said responsibility shall not be released until the project has 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 non-execution thereof by the Contractor, the Contractor shall restore, at their 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 the Contractor shall make good such damage or injury in an acceptable manner.

70-11 Responsibility for damage claims. The Contractor shall indemnify and hold harmless the Engineer/RPR and the Owner and their officers, agents, 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 their own contract considered necessary by the Owner for such purpose may be retained for the use of the Owner or, in case no money is due, their own surety may be held until such suits, actions, or claims for injuries or damages 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 or she 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 for 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. If it is 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 must be specified below ~~and indicated on the approved Construction Safety and Phasing Plan (CSPP)~~

and on the project plans. When so specified, the Contractor shall complete such portions of the work on or before the date specified or as otherwise specified.

Upon completion of any portion of work listed above, such portion shall be accepted by the Owner in accordance with Section 50, paragraph 50-14, *Partial Acceptance*.

No portion of the work may be opened by the Contractor until directed by the Owner in writing. Should it become necessary to open a portion of the work to traffic on a temporary or intermittent basis, such openings shall be made when, in the opinion of the RPR, 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 their expense.

The Contractor shall make their 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.

The Contractor must conform to safety standards contained AC 150/5370-2. ~~and the approved CSPP.~~

Contractor shall refer to the plans and specifications, ~~and the approved CSPP~~ to identify barricade requirements, temporary and/or permanent markings, airfield lighting, guidance signs and other safety requirements prior to opening up sections of work to traffic.

70-14 Contractor's responsibility for work. Until the RPR's final written acceptance of the entire completed work, excepting only those portions of the work accepted in accordance with Section 50, paragraph 50-14, *Partial Acceptance*, 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 non-execution 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 their own 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, seeding, and sodding furnished under the 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 paragraph 70-04, *Restoration of Surfaces Disturbed by Others*, 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 their 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/or in the contract documents.

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 the 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 their plan of operations. Such notification shall be in writing addressed to "The Person to Contact" as provided in this paragraph and paragraph 70-04, *Restoration of Surfaces Disturbed By Others*. A copy of each notification shall be given to the RPR.

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 their plan of operations that would affect such Owners.

Prior to beginning the work in the general vicinity of an existing utility service or facility, the Contractor shall again notify each such Owner of their 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 RPR.

The Contractor's failure to give the two days' notice shall be cause for the Owner 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 hand excavation methods within 3 feet (1 m) 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, the Contractor shall immediately notify the proper authority and the RPR 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 RPR 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 their operations whether 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 their own surety.

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 by this contract, there shall be no liability upon the Engineer, RPR, their 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 stop the Owner from correcting any measurement, estimate, or certificate made before or after completion of the work, nor shall the Owner be precluded or stopped from recovering from the Contractor or their surety, or both, such overpayment as may be sustained, or by failure on the part of the Contractor to fulfill their 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. The Contractor shall take necessary precautions to prevent pollution of streams, lakes, ponds, and reservoirs with fuels, oils, asphalts, 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 their operations, any building, part of a building, structure, or object that is incongruous with its surroundings, the Contractor shall immediately cease operations in that location and notify the RPR. The RPR will immediately investigate the Contractor's finding and the Owner will direct the Contractor to either resume operations or to suspend operations as directed.

Should the Owner 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 change order or supplemental agreement as provided in Section 40, paragraph 40-04, *Extra Work*, and Section 90, paragraph 90-05, *Payment for Extra Work*. If appropriate, the contract change order or supplemental agreement shall include an extension of contract time in accordance with Section 80, paragraph 80-07, *Determination and Extension of Contract Time*.

~~70-21 Insurance Requirements.~~—Insert local insurance requirements for the project.

END OF SECTION 70

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SECTION 80 EXECUTION 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 Resident Project Representative (RPR).

The Contractor shall perform, with his organization, an amount of work equal to at least **40** percent of the total contract cost.

Should the Contractor elect to assign their 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.

The Contractor shall provide copies of all subcontracts to the RPR 14 days prior to being utilized on the project. As a minimum, the information shall include the following:

- Subcontractor's legal company name.
- Subcontractor's legal company address, including County name.
- Principal contact person's name, telephone and fax number.
- Complete narrative description, and dollar value of the work to be performed by the subcontractor.
- Copies of required insurance certificates in accordance with the specifications.
- Minority/ non-minority status.

80-02 Notice to proceed (NTP). The Owners notice to proceed will state the date on which contract time commences. The Contractor is expected to commence project operations within **10** days of the NTP date. The Contractor shall notify the RPR at least 48 hours in advance of the time contract operations begins. The Contractor shall not commence any actual operations prior to the date on which the notice to proceed is issued by the Owner.

80-03 Execution and progress. Unless otherwise specified, the Contractor shall submit their coordinated construction schedule showing all work activities for the RPR's review and acceptance at least 14 days prior to the start of work. The Contractor's progress schedule, once accepted by the RPR, will represent the Contractor's baseline plan to accomplish the project in accordance with the terms and conditions of the Contract. The RPR will compare actual Contractor progress against the baseline schedule to determine that status of the Contractor's performance. 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 RPR's request, submit a revised schedule for completion of the work within the contract time and modify their operations to provide such additional materials, equipment, and labor necessary to meet the revised schedule. Should the execution of the work be discontinued for any reason, the Contractor shall notify the RPR at least 48 hours in advance of resuming operations.

The Contractor shall not commence any actual construction prior to the date on which the NTP is issued by the Owner.

The project schedule shall be prepared as a network diagram in Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), or other format, or as otherwise specified. It shall include information on the sequence of work activities, milestone dates, and activity duration. The schedule shall show all work items identified in the project proposal for each work area and shall include the project start date and end date.

The Contractor shall maintain the work schedule and provide an update and analysis of the progress schedule on a **twice** monthly basis, or as otherwise specified in the contract. Submission of the work schedule shall not relieve the Contractor of overall responsibility for scheduling, sequencing, and coordinating all work to comply with the requirements of the contract.

80-04 Limitation of operations. The Contractor shall control their operations and the operations of their subcontractors and all suppliers to provide for the free and unobstructed movement of aircraft in the air operations areas (AOA) of the airport.

When the work requires the Contractor to conduct their operations within an AOA of the airport, the work shall be coordinated with airport operations (through the RPR) at least 48 hours prior to commencement of such work. The Contractor shall not close an AOA until so authorized by the RPR and until the necessary temporary marking, signage and associated lighting is in place.

When the contract work requires the Contractor to work within an AOA of the airport on an intermittent basis (intermittent opening and closing of the AOA), the Contractor shall maintain constant communications as specified; immediately obey all instructions to vacate the AOA; and immediately obey all instructions to resume work in such AOA. Failure to maintain the specified communications or to obey instructions shall be cause for suspension of the Contractor's operations in the AOA until satisfactory conditions are provided. The areas of the AOA identified and as listed below, 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:

See Plan Sheets and Drawings

The Contractor shall be required to conform to safety standards contained in AC 150/5370-2, Operational Safety on Airports During Construction.

80-04.1 Operational safety on airport during construction. All Contractors' operations shall be conducted in accordance with the provisions set forth within the current version of AC 150/5370-2, Operational Safety on Airports During Construction.

The Contractor shall implement all necessary safety plan measures prior to commencement of any work activity. The Contractor shall conduct routine checks to assure compliance with the AC 150/5370-2.

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 AC 150/5370-2 and that they implement and maintain all necessary measures.

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.

Any person employed by the Contractor or by any subcontractor who violates any operational regulations or operational safety requirements and, in the opinion of the RPR, does not perform his work in a proper and skillful manner or is intemperate or disorderly shall, at the written request of the RPR, be removed immediately by the Contractor or subcontractor employing such person, and shall not be employed again in any portion of the work without approval of the RPR.

Should the Contractor fail to remove such person or persons, or fail to furnish suitable and sufficient personnel for the proper execution of the work, the RPR may suspend the work by written notice until compliance with such orders.

All equipment that 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 not cause injury to previously completed work, adjacent property, or existing airport facilities due to 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 otherwise authorized by the RPR. If the Contractor desires to use a method or type of equipment other than specified in the contract, the Contractor may request authority from the RPR 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 RPR 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 RPR 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 paragraph.

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 the Owner may deem necessary, due to unsuitable weather, or other conditions considered unfavorable for the execution of the work, or for such time 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 written order to suspend work to the effective date of the written order to resume the work. Claims for such compensation shall be filed with the RPR within the time period stated in the RPR's order to resume work. The Contractor shall submit with their own claim information substantiating the amount shown on the claim. The RPR 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 or for any other delay provided for in the contract, plans, or specifications.

If it becomes 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. The Contractor 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 days ~~the number of working days~~ ~~the completion date~~ shall be stated in the proposal and contract and shall be known as the Contract Time.

If the contract time requires extension for reasons beyond the Contractor's control, it shall be adjusted as follows:

~~**80-07.1 Contract time based on working days.** Contract time based on working days shall be calculated weekly by the Resident Project Representative (RPR). The RPR will furnish the Contractor a copy of their 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 weekly statement of contract time charged is based on the following considerations:~~

~~(1) Time will be charged for days on which the Contractor could proceed with scheduled work under construction at the time for at least six (6) hours with the normal work force employed on such items. When normal work force is a double shift, use 12 hours; and when the normal work force is on a triple shift, use 18 hours. Conditions beyond the Contractor's control such as strikes, lockouts, unusual delays in transportation, temporary suspension of the scheduled work items 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 RPR will not make charges against the contract time prior to the effective date of the notice to proceed.~~

~~(3) The RPR will begin charges against the contract time on the first working day after the effective date of the notice to proceed.~~

~~(4) The RPR will not make charges against the contract time after the date of final acceptance as defined in Section 50, paragraph 50-14, *Final Acceptance*.~~

~~(5) The Contractor will be allowed one (1) week in which to file a written protest setting forth their own objections to the RPR'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 Section 20, paragraph 20-05, *Interpretation of Estimated Proposal Quantities*. 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.~~

Contract time based on calendar days. 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 non-work 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.

~~**Contract time based on specific completion date.** When the contract time is a specified completion date, it shall be the date on which all contract work shall be substantially complete.~~

~~If the Contractor finds it impossible for reasons beyond their own control to complete the work within the contract time as specified, or as extended in accordance with the provisions of this paragraph, the Contractor may, at any time prior to the expiration of the contract time as extended, make a written request to the Owner for an extension of time setting forth the reasons which the Contractor believes will justify the granting of their own request. Requests for extension of time, caused by inclement weather, shall be supported with National Weather Bureau data showing the actual amount of inclement weather exceeded what 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 supporting documentation justify the work was delayed because of conditions beyond the control and without the fault of the Contractor, the Owner may extend the time for completion by a change order that adjusts the contract time or completion date. 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 paragraph 80-07, *Determination and Extension of Contract Time*) the sum specified in the contract and proposal as liquidated damages (LD) will be deducted from any money due or to become due the Contractor or their own surety. Such deducted sums shall not be deducted as a penalty but shall be considered as liquidation of a reasonable portion of damages including but not limited to additional engineering services that will be incurred by the Owner should the Contractor fail to complete the work in the time provided in their contract.

DESCRIPTION	<u>COLUMN I</u> Calendar Days per Phase	COLUMN II Liquidated Damages per Calendar Day if Work is not Completed by the Calendar Days Shown in Column I
Mobilization*	60 Calendar Days	\$250.00
All Construction Phases	120 Calendar Days	\$1000.00
Substantial Completion	15 Calendar Days	\$1000.00
Total Project	195 Calendar Days	\$1000.00

* Mobilization includes submittals and building permits.

The maximum construction time allowed for Schedules will be the sum of the time allowed for individual schedules but not more than **195 Calendar** days. 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 their 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 and/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 execution 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 the Contractor 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 Owner consider the Contractor in default of the contract for any reason above, the Owner 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 RPR 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 execution 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 RPR 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 execution 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 RPR.

Termination of the contract or a portion thereof shall neither relieve the Contractor of their responsibilities for the completed work nor shall it relieve their 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 RPR 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 work in accordance with the approved CSPP and SPCD.

END OF SECTION 80

SECTION 90 MEASUREMENT AND PAYMENT

90-01 Measurement of quantities. All work completed under the contract will be measured by the RPR, or their authorized representatives, using united States Customary Units of Measurement ~~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 meters) 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 RPR.

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.

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.

When requested by the Contractor and approved by the RPR 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 RPR and shall be agreed to by the Contractor before such method of measurement of pay quantities is used.

Measurement and Payment Terms

Term	Description
Excavation and Embankment Volume	In computing volumes of excavation, the average end area method will be used unless otherwise specified.
Measurement and Proportion by Weight	The term “ton” will mean the short ton consisting of 2,000 pounds (907 kg) avoirdupois. All materials that are measured or proportioned by weights shall be weighed on accurate, independently certified scales by competent, qualified personnel at locations designated by the RPR. If material is shipped by rail, the car weight may be accepted provided that only the actual weight of material is 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 RPR directs, and each truck shall bear a plainly legible identification mark.
Measurement by Volume	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 for the materials hauled, 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.
Asphalt Material	Asphalt materials will be measured by the gallon (liter) or ton (kg). When measured by volume, such volumes will be measured at 60°F (16°C) or will be corrected to the volume at 60°F (16°C) using ASTM D1250 for asphalts. 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 asphalt material has been lost from the car or the distributor, wasted, or otherwise not incorporated in the work. When asphalt materials are shipped by truck or transport, net certified weights by volume, subject to

Term	Description
	correction for loss or foaming, will be used for computing quantities.
Cement	Cement will be measured by the ton (kg) or hundredweight (km).
Structure	Structures will be measured according to neat lines shown on the plans or as altered to fit field conditions.
Timber	Timber will be measured by the thousand feet board measure (MFBM) actually incorporated in the structure. Measurement will be based on nominal widths and thicknesses and the extreme length of each piece.
Plates and Sheets	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 inch.
Miscellaneous Items	When standard manufactured items are specified such as fence, wire, plates, rolled shapes, pipe conduit, etc., and these items are identified by gauge, 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	Scales must be tested for accuracy and serviced before use. 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. Platform scales shall be installed and maintained with the platform level and rigid bulkheads at each end. Scales shall be accurate within 0.5% of the correct weight throughout the range of use. The Contractor shall have the scales checked under the observation of the RPR 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 0.1% of the nominal rated capacity of the scale, but not less than one pound (454 grams). The use of spring balances will not be permitted. In the event inspection reveals the scales have been “overweighing” (indicating more than correct weight) they will be immediately adjusted. All materials received subsequent to the last previous correct weighting-accuracy test will be reduced by the percentage of error in excess of 0.5%. In the event inspection reveals the scales have been under-weighing (indicating less than correct weight), they shall be immediately adjusted. No additional payment to the Contractor will be allowed for materials previously weighed and recorded. Beams, dials, platforms, and other scale equipment shall be so arranged that the operator and the RPR can safely and conveniently view them. Scale installations shall have available ten standard 50-pound (2.3 km) weights for testing the weighing equipment or suitable weights and devices for other approved equipment. 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.
Rental Equipment	Rental of equipment will be measured by time in hours of actual working time and

Term	Description
	necessary traveling time of the equipment within the limits of the work. Special equipment ordered in connection with extra work will be measured as agreed in the change order or supplemental agreement authorizing such work as provided in paragraph 90-05 <i>Payment for Extra Work</i> .
Pay Quantities	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 RPR. 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 execution thereof, subject to the provisions of Section 70, paragraph 70-18, *No Waiver of Legal Rights*.

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 Section 40, paragraph 40-02, *Alteration of Work and Quantities*, 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 their own unbalanced allocation of overhead and profit among the contract items, or from any other cause.

90-04 Payment for omitted items. As specified in Section 40, paragraph 40-03, *Omitted Items*, the RPR 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 RPR 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 RPR’s order to omit or non-perform such contract item.

Acceptable materials ordered by the Contractor or delivered on the work prior to the date of the RPR’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 RPR’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 work. Extra work, performed in accordance with Section 40, paragraph 40-04, *Extra Work*, will be paid for at the contract prices or agreed prices specified in the change order or supplemental agreement authorizing the extra work.

90-06 Partial payments. Partial payments will be made to the Contractor at least once each month as the work progresses. Said payments will be based upon estimates, prepared by the RPR, of the value of the work performed and materials complete and 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 paragraph 90-07, *Payment for Materials on Hand*. No partial payment will be made when the amount due to the Contractor since the last estimate amounts to less than five hundred dollars.

Option 3

a. 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 for protection of the Owner's interests. Unless otherwise instructed by the Owner, the amount retained by the Owner will be in effect until the final payment is made except as follows:

(1) Contractor may request release of retainage on work that has been partially accepted by the Owner in accordance with Section 50-03. Contractor must provide a certified invoice to the RPR that supports the value of retainage held by the Owner for partially accepted work.

(2) In lieu of retainage, the Contractor may exercise at its option the establishment of an escrow account per paragraph 90-08.

b. The Contractor is required to pay all subcontractors for satisfactory performance of their contracts no later than 30 days after the Contractor has received a partial payment. Contractor must provide the Owner evidence of prompt and full payment of retainage held by the prime Contractor to the subcontractor within 30 days after the subcontractor's work is satisfactorily completed. A subcontractor's work is satisfactorily completed when all the tasks called for in the subcontract have been accomplished and documented as required by the Owner. When the Owner has made an incremental acceptance of a portion of a prime contract, the work of a subcontractor covered by that acceptance is deemed to be satisfactorily completed.

c. When at least 95% of the work has been completed to the satisfaction of the RPR, the RPR shall, at the Owner's discretion and with the consent of the surety, prepare estimates of both the contract value and the cost of the remaining work to be done. The Owner may retain 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 RPR 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 paragraph 90-09, *Acceptance and Final Payment*.

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 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 RPR at or on an approved site.

b. The Contractor has furnished the RPR with acceptable evidence of the quantity and quality of such stored or stockpiled materials.

c. The Contractor has furnished the RPR 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 stored or stockpiled.

e. The Contractor has furnished the Owner evidence that the material stored or stockpiled is insured against loss by damage to or disappearance of such materials at any time 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 their 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 paragraph.

90-08 Payment of withheld funds. At the Contractor's option, if an Owner withholds retainage in accordance with the methods described in paragraph 90-06 *Partial Payments*, the Contractor may request that the Owner deposit the retainage into an escrow account. The Owner's deposit of retainage into an escrow account is subject to 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 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 Section 50, paragraph 50-15, *Final Acceptance*, the RPR will prepare the final estimate of the items of work actually performed. The Contractor shall approve the RPR's final estimate or advise the RPR of the Contractor's 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 RPR 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 RPR's final estimate. If, after such 30-day period, a dispute still exists, the Contractor may approve the RPR'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 Section 50, paragraph 50-16, *Claims for Adjustment and Disputes*.

After the Contractor has approved, or approved under protest, the RPR's final estimate, and after the RPR's receipt of the project closeout documentation required in paragraph 90-11, *Contractor Final Project Documentation*, 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 Section 50, paragraph 50-16, *Claims for Adjustments and Disputes*, or under the provisions of this paragraph, 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.

90-10 Construction warranty.

a. In addition to any other warranties in this contract, the Contractor warrants that work performed under this contract conforms to the contract requirements and is free of any defect in equipment, material, workmanship, or design furnished, or performed by the Contractor or any subcontractor or supplier at any tier.

b. This warranty shall continue for a period of one year from the date of final acceptance of the work, except as noted. If the Owner takes possession of any part of the work before final acceptance, this warranty shall continue for a period of one year from the date the Owner takes possession. However, this will not relieve the Contractor from corrective items required by the final acceptance of the project work. Light Emitting Diode emitting diode (LED) light fixtures with the exception of obstruction lighting, must be warranted by the manufacturer for a minimum of four (4) years after date of installation inclusive of all electronics.

c. The Contractor shall remedy at the Contractor's expense any failure to conform, or any defect. In addition, the Contractor shall remedy at the Contractor's expense any damage to Owner real or personal property, when that damage is the result of the Contractor's failure to conform to contract requirements; or any defect of equipment, material, workmanship, or design furnished by the Contractor.

d. The Contractor shall restore any work damaged in fulfilling the terms and conditions of this clause. The Contractor's warranty with respect to work repaired or replaced will run for one year from the date of repair or replacement.

e. The Owner will notify the Contractor, in writing, within seven (7) days after the discovery of any failure, defect, or damage.

f. If the Contractor fails to remedy any failure, defect, or damage within 14 days after receipt of notice, the Owner shall have the right to replace, repair, or otherwise remedy the failure, defect, or damage at the Contractor's expense.

g. With respect to all warranties, express or implied, from subcontractors, manufacturers, or suppliers for work performed and materials furnished under this contract, the Contractor shall: (1) Obtain all warranties that would be given in normal commercial practice; (2) Require all warranties to be executed, in writing, for the benefit of the Owner, as directed by the Owner, and (3) Enforce all warranties for the benefit of the Owner.

h. This warranty shall not limit the Owner's rights with respect to latent defects, gross mistakes, or fraud.

90-11 Contractor Final Project Documentation. Approval of final payment to the Contractor is contingent upon completion and submittal of the items listed below. The final payment will not be approved until the RPR approves the Contractor's final submittal. The Contractor shall:

a. Provide two (2) copies of all manufacturers warranties specified for materials, equipment, and installations.

b. Provide weekly payroll records (not previously received) from the general Contractor and all subcontractors.

c. Complete final cleanup in accordance with Section 40, paragraph 40-08, *Final Cleanup*.

d. Complete all punch list items identified during the Final Inspection.

e. Provide complete release of all claims for labor and material arising out of the Contract.

f. Provide a certified statement signed by the subcontractors, indicating actual amounts paid to the Disadvantaged Business Enterprise (DBE) subcontractors and/or suppliers associated with the project.

g. When applicable per state requirements, return copies of sales tax completion forms.

h. Manufacturer's certifications for all items incorporated in the work.

i. All required record drawings, as-built drawings or as-constructed drawings.

j. Project Operation and Maintenance (O&M) Manual(s).

k. Security for Construction Warranty.

l. Equipment commissioning documentation submitted, if required.

END OF SECTION 90



Contract Provision Guidelines for Obligated Sponsors and Airport Improvement Program Projects: SECTION 130

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RECORD OF CHANGES

No.	Date	Item	Change
1	1/29/2016	Entire Document	Re-structured document to enhance user understanding of use and applicability; added suggested provisions for “Termination for Cause”, “Recovered Materials”, “Seismic Safety”.
2	6/10/2016	Table 1	Distracted Driving: Updated “Dollar Threshold” to \$3,500 to reflect current micro-purchase threshold.
3	6/10/2016	A2, Affirmative Action	Update the reference to the Department of Labor online document to be “Participation Goals for Minority and Females”
4	6/10/2016	A12, Disadvantaged Business Enterprise	A12.3: Changed Title to “Required Provisions” A12.3.1: Corrected starting timeframe for submitting written confirmation from “Owner Notice of Award” to “bid opening” A12.3.1: Provided two sets of last paragraphs to reflect change (7 days to 5 days) that occurs on December 31, 2016. A12.3.2: Moved Race/Gender Neutral language up and renamed heading to reflect text is solicitation language. A12.3.3: Moved and renamed contract clause information and clarified it is for prime contract covered by a DBE program.
5	12/12/2017	Cover	Change title of document for clarity
6	12/12/2017	1. Purpose of this Document	Added clarifying text addressing purpose and limitations of this guidance. 1.7-1.9: Added definitions of contract, applicant, bid
7	12/12/2017	2. Sponsor requirements	Added clarifying text addressing sponsor responsibilities.

No.	Date	Item	Change
8	12/12/2017	3. Typical Procurement Steps	Added clarifying text for typical procurement process steps.
9	12/12/2017	Table 1 – Applicability Matrix	Re-arranged table in alphabetic order. Added “Solicitation” column to address solicitation provisions Item 1, Seismic Safety: Added Limited Application Added note on Airport Concessions Disadvantaged Business Enterprises
10	12/12/2017	All Clauses	Clarifying revisions made to applicability section.
11	12/12/2017	A5, Civil Rights - General	Rephrased General Civil Rights Provision to simplify language and to clarify duration of obligation for tenant/concessionaire/lessee
12	12/12/2017	A6.3.1 Civil Rights – Solicitations	Added sponsor must select either DBE or ACDBE
12	12/12/2017	A12, Disadvantaged Business Enterprise	The deadline to submit DBE confirmation of participation is now 5 days after bid opening or as a matter of bid responsiveness. Updated DBE contract assurance (12.3.3) to match language of 49 CFR § 26.13
13	12/12/2017	A24, Tax Delinquency and Felony Conviction	New certification addressing contractor tax delinquency and felony conviction.
14	6/19/2018	6.2.1, Applicability of Title VI Solicitation Notice	For Title VI Clauses for Compliance with Nondiscrimination Requirements, change second sentence in second column to changed “are already subject to nondiscrimination requirements” to “are not already subject to nondiscrimination requirements”.
15	6/19/2018	A6.4.1, Title VI Clauses for Compliance with Nondiscrimination Requirements	In second item, changed “are already subject to nondiscrimination requirements” to “are not already subject to nondiscrimination requirements”.

CONTRACT GUIDANCE

1. Purpose of this Document

- 1) The purpose of this document is to establish a convenient resource for Sponsors that consolidates all possible provisions and clauses into one document that includes an applicability matrix. This document itself does not create, revise or delete requirements for participation in the Airport Improvement Program. The source of requirements addressed within this document are identified within the section for each individual clause.
- 2) Federal laws and regulations require that an sponsor (a recipient of federal assistance) include specific clauses in certain contracts, solicitations, or specifications regardless of whether or not the project is federally funded.
- 3) The term **sponsor** is used in this document to mean either an obligated sponsor on a project that is not federally funded, or a sponsor on an AIP funded project.
- 4) The term **Owner** is generally used in the solicitation or contract clauses because of its common use in public contracts.
- 5) An Owner becomes an obligated sponsor upon acceptance of the Airport Improvement Program (AIP) grant assurances associated with current or prior AIP grant funded projects.
- 6) For purposes of determining requirements for contract provisions, the term **contract** includes subcontracts and supplier contracts such as purchase orders.
- 7) For purpose of remaining compliant with its obligations, a sponsor must incorporate applicable contract provisions in all its procurements and contract documents. Unless otherwise stated, these provisions flow down to subcontracts and sub-tier agreements.
- 8) The term **contractor** is understood to mean a contractor, subcontractor, or consultant; and means one who participates, through a contract or subcontract (at any tier).
- 9) The term **bid** is understood to mean a bid, an offer, or a proposal.
- 10) **Applicant:**
 - a. For the Equal Employment Opportunity (EEO) clause, the term **applicant** means an applicant for employment (whether or not the phrase, *for employment*, follows the word applicant or applicants).
 - b. For all other clauses, the term **applicant** means a bidder, offeror, or proposer for a contract.

2. Sponsor Requirements

In general, the sponsor must take the following actions in order to remain consistent with its obligations:

- 1) Include in its procurements the provisions that are applicable to its project.
- 2) Not incorporate the entire contract provisions guidelines in its solicitation or contract documents, whether by reference or by inclusion in whole. Incorporation of this entire guidance document creates potential for ambiguous interpretation and may lead to improper application that

unnecessarily increases price. A sponsor that fails to properly incorporate applicable contract clauses may place themselves at risk for audit findings or denial of Federal funding.

- 3) Incorporate applicable contract provisions using mandatory language as required. The subheading entitled *Applicability* advises whether a particular clause or provision has mandatory language that a sponsor must use.
 - (a) Mandatory Language - Whenever a clause or provision has mandatory text, the sponsor must incorporate the text of the provision **without change**, except where specific adaptive input is necessary (e.g. such as the sponsor's name).
 - (b) No Mandatory Language Provided - For provisions without mandatory language, this guidance provides model language acceptable to the FAA. Some sponsors may already have standard procurement language that is equivalent to those federal provisions. In these cases, sponsors may use their existing standard procurement provision language provided the text meets the intent and purpose of the Federal law or regulation.
- 4) Require the contractor (including all subcontractors) to insert these contract provisions in each lower tier contract (e.g. subcontract or sub-agreement).
- 5) Require the contractor (including all subcontractors) to incorporate the applicable requirements of these contract provisions by reference for work done under any purchase orders, rental agreements and other agreements for supplies or services.
- 6) Require that the prime contractor be responsible for compliance with these contract provisions by any subcontractor, lower-tier subcontractor or service provider.
- 7) Verify that any required local or State provision does not conflict with or alter a Federal law or regulation.

3. Typical Procurement Steps

The usual procurement steps in a project are:

- 1) Solicitation, Request for Bids or Request for Proposals – This is also called the Advertisement or Notice to Bidders.
- 2) Bidding or Accepting Proposals – In this stage, the bidders receive a complete set of the procurement documents, also known as the project manual. The project manual will typically include a copy of the solicitation, instructions-to-bidders, bid forms, certifications and representations, general provisions, contract conditions, copy of contract, project drawings, technical specifications and related project documents.
- 3) Bid/Proposal Evaluation – Period when Sponsor tabulates and reviews all proposals for bid responsiveness and bidder responsibility.
- 4) Award – Point when the Sponsor formally awards the contract to the successful bidder.
- 5) Execution of Contract – Point at which the Sponsor formally enters into a legally binding agreement to perform services or provide goods.

4. Applicability Matrix for Contract Provisions

[Table 1](#) summarizes the applicability of contract provisions based upon the type of contract or agreement. The dollar threshold represents the value at which, when equal to or exceeded, the sponsor must incorporate the provision in the contract or agreement.

Supplemental information addressing applicability and use for each provision is located in Appendix A. Appendix A and the Matrix include notes indicating when the sponsor may incorporate references in the **solicitation** in lieu of including the entire text.

Meaning of cell values

- Info – Sponsor has discretion on whether to include clause in its contracts.
- Limited – Provision with limited applicability depending on circumstances of the procurement.
- n/a – Provision that is not applicable for that procurement type.
- NIS – Provision that does not need to be included or referenced in the solicitation document
- REF – Provision to be incorporated into the solicitation by reference.
- REQD - Provision the sponsor must incorporate into procurement documents.

Table 1 – Applicability of Provisions

Provisions/Clauses	Dollar Threshold	Solicitation	Professional Services	Construction	Equipment	Property (Land)	Non-AIP Contracts
Access to Records and Reports	\$ 0	NIS	REQD	REQD	REQD	REQD	n/a
Affirmative Action Requirement	\$10,000	REQD	Limited	REQD	Limited	Limited	n/a
Breach of Contract	\$150,000	NIS	REQD	REQD	REQD	REQD	n/a
Buy American Preferences	\$ 0	REF	Limited	REQD	REQD	Limited	n/a
(1) Buy American Statement	\$ 0	NIS	Limited	REQD	REQD	Limited	n/a
(2) BA – Total Facility	\$ 0	NIS	Limited	REQD	REQD	Limited	n/a
(3) B.A. – Manufactured Product	\$ 0	NIS	Limited	REQD	REQD	Limited	n/a
Civil Rights – General	\$ 0	NIS	REQD	REQD	REQD	REQD	REQD
Civil Rights - Title VI Assurances	\$ 0	REF	REQD	REQD	REQD	REQD	REQD
(1) Notice - Solicitation	\$ 0	REQD	REQD	REQD	REQD	REQD	REQD
(2) Clause - Contracts	\$ 0	NIS	REQD	REQD	REQD	REQD	REQD
(3) Clause – Transfer of U.S. Property	\$ 0	NIS	n/a	n/a	n/a	Limited	REQD
(4) Clause – Transfer of Real Property	\$ 0	NIS	n/a	n/a	n/a	REQD	REQD
(5) Clause - Construct/Use/Access to Real Property	\$ 0	NIS	n/a	n/a	n/a	REQD	REQD
(6) List – Pertinent Authorities	\$0	NIS	REQD	REQD	REQD	REQD	REQD
Clean Air/Water Pollution Control	\$150,000	NIS	REQD	REQD	REQD	REQD	n/a
Contract Work Hours and Safety Standards	\$100,000	NIS	Limited	REQD	Limited	Limited	n/a
Copeland Anti-Kickback	\$ 2,000	NIS	Limited	REQD	Limited	Limited	n/a
Davis Bacon Requirements	\$ 2,000	REF	Limited	REQD	Limited	Limited	n/a
Debarment and Suspension	\$25,000	REF	REQD	REQD	REQD	Limited	n/a
Disadvantaged Business Enterprise	\$ 0	REF	REQD	REQD	REQD	REQD	n/a
Distracted Driving	\$3,500	NIS	REQD	REQD	REQD	REQD	n/a
Energy Conservation Requirements	\$ 0	NIS	REQD	REQD	REQD	REQD	n/a
Equal Employment Opportunity	\$10,000	NIS	Limited	REQD	Limited	Limited	n/a
(1) EEO Contract Clause	\$10,000	NIS	Limited	REQD	Limited	Limited	n/a
(2) EEO Specification	\$10,000	NIS	Limited	REQD	Limited	Limited	n/a
Federal Fair Labor Standards Act	\$ 0	NIS	REQD	REQD	REQD	REQD	Info
Foreign Trade Restriction	\$ 0	REF	REQD	REQD	REQD	REQD	n/a
Lobbying Federal Employees	\$ 100,000	REF	REQD	REQD	REQD	REQD	n/a
Occupational Safety and Health Act	\$ 0	NIS	REQD	REQD	REQD	REQD	Info
Prohibition of Segregated Facilities	\$10,000	NIS	Limited	REQD	Limited	Limited	n/a
Recovered Materials	\$10,000	REF	Limited	REQD	REQD	Limited	n/a
Rights to Inventions	\$ 0	NIS	Limited	Limited	Limited	n/a	n/a
Seismic Safety	\$ 0	NIS	Limited	Limited	Limited	n/a	n/a
Tax Delinquency and Felony Conviction	\$ 0	NIS	REQD	REQD	REQD	REQD	n/a
Termination of Contract	\$10,000	NIS	REQD	REQD	REQD	REQD	n/a
Veteran's Preference	\$ 0	NIS	REQD	REQD	REQD	REQD	n/a

Airport Concessions Disadvantage Business Enterprise (ACDBE) Notes:

1. Language relative to solicitation for ACDBEs does not need to be included in AIP funded solicitations, since in no case are concessions activities funded with federal funds.
2. Airport sponsors must include the appropriate Title VI language in their solicitation notices when they seek proposals for concessions.

APPENDIX A – CONTRACT PROVISIONS

A1 ACCESS TO RECORDS AND REPORTS

A1.1 SOURCE

2 CFR § 200.333

2 CFR § 200.336

FAA Order 5100.38

A1.2 APPLICABILITY

2 CFR § 200.333 requires a sponsor to retain records pertinent to a Federal award for a period of three years from submission of final closure documents. 2 CFR § 200.336 establishes that sponsors must provide Federal entities the right to access records pertinent to the Federal award. FAA policy extends these requirements to the sponsor's contracts and subcontracts of AIP funded projects.

Contract Types – The sponsor must include this provision in all contracts and subcontracts of AIP funded projects.

Use of Provision – No mandatory language provided. The following language is acceptable to the FAA with meeting the intent of this requirement. If the sponsor prefers to use different language, the sponsor's language must fully satisfy the requirements of §§ 200.333 and 200.336.

A1.3 CONTRACT CLAUSE

ACCESS TO RECORDS AND REPORTS

The Contractor must maintain an acceptable cost accounting system. The Contractor agrees to provide the Owner, the Federal Aviation Administration and the Comptroller General of the United States or any of their duly authorized representatives access to any books, documents, papers and records of the Contractor which are directly pertinent to the specific contract for the purpose of making audit, examination, excerpts and transcriptions. The Contractor agrees to maintain all books, records and reports required under this contract for a period of not less than three years after final payment is made and all pending matters are closed.

A2 AFFIRMATIVE ACTION REQUIREMENT

A2.1 SOURCE

41 CFR part 60-4

Executive Order 11246

A2.2 APPLICABILITY

Minority Participation. Sponsors are required to set goals for minority participation in AIP funded projects exceeding \$10,000. The goals for minority participation derive from Economic Area (EA) and Standard Metropolitan Statistical Area (SMSA) as established in Volume 45 of the Federal Register dated 10/3/80. Page 65984 contains a table of all EAs and SMSAs and the associated minority participation goals.

To find the goals for minority participation, a sponsor must either refer to the Federal Register Notice or to the Department of Labor online document, "[Participation Goals for Minorities and Females](#)". EAs and SMSAs span state boundaries. A sponsor may have to refer to entries for adjacent states in order to locate the goal for the project location.

Female Participation. Executive Order 11246 has set a goal of 6.9% nationally for female participation for all construction projects. This value remains constant for all counties and states.

Contract Types –

Construction – The sponsor must incorporate this notice in all solicitations for bids or requests for proposals for AIP funded construction work contracts and subcontracts that exceed \$10,000. Construction work means construction, rehabilitation, alteration, conversion, extension, demolition or repair of buildings, highways or other changes or improvements to real property, including facilities providing utility services. The term also includes the supervision, inspection and other onsite functions incidental to the actual construction.

Equipment – The sponsor must incorporate this notice in any equipment project exceeding \$10,000 that involves installation of equipment onsite (e.g. electrical vault equipment). This provision does not apply to equipment acquisition projects where the manufacture of the equipment takes place offsite at a manufacturer's plant (e.g. firefighting and snow removal vehicles).

Professional Services – The sponsor must incorporate this notice in any professional service agreement if the professional services agreement includes tasks that meet the definition of construction work [as defined by the U.S. Department of Labor (DOL)] and exceeds \$10,000. Examples include installation of monitoring systems (e.g. noise, environmental, etc.).

Property/Land – The sponsor must incorporate this notice in any agreement associated with land acquisition if the agreement includes construction work (defined above) that exceeds \$10,000. Examples include demolition of structures or installation of boundary fencing.

Use of Provision – MANDATORY TEXT. The sponsor must:

- (a) Incorporate the text of this provision in its solicitations without modification.

- (b) Incorporate the applicable minority participation goal and the covered area by geographic name.
- (c) Not simply insert a reference to the 1980 Federal Register Notice.

A2.3 SOLICITATION CLAUSE

NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION to ENSURE EQUAL EMPLOYMENT OPPORTUNITY

1. The Offeror's or Bidder's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Opportunity Construction Contract Specifications" set forth herein.
2. The goals and timetables for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

Timetables

Goals for minority participation for each trade: ***[sponsor must insert established goal]***

Goals for female participation in each trade: 6.9%

These goals are applicable to all of the Contractor's construction work (whether or not it is Federal or federally assisted) performed in the covered area. If the Contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for such geographical area where the work is actually performed. With regard to this second area, the Contractor also is subject to the goals for both its federally involved and non-federally involved construction.

The Contractor's compliance with the Executive Order and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR 60-4.3(a) and its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the Contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, the Executive Order and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

3. The Contractor shall provide written notification to the Director of the Office of Federal Contract Compliance Programs (OFCCP) within 10 working days of award of any construction subcontract in excess of \$10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the name, address, and telephone number of the subcontractor; employer identification number of the subcontractor; estimated dollar amount of the subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the subcontract is to be performed.

4. As used in this notice and in the contract resulting from this solicitation, the "covered area" is **City of Savannah, County of Chatham, State of Georgia.**

A3 BREACH OF CONTRACT TERMS

A3.1 SOURCE

2 CFR § 200 Appendix II(A)

A3.2 APPLICABILITY

This provision requires sponsors to incorporate administrative, contractual or legal remedies if contractor violate or breach contract terms. The sponsor must also include appropriate sanctions and penalties.

Contract Types – This provision is required for all contracts that exceed the simplified acquisition threshold as stated in 2 CFR Part 200, Appendix II (A). This threshold is occasionally adjusted for inflation and is now equal to \$150,000.

Use of Provision – No mandatory language provided. The following language is acceptable to the FAA as meeting the intent of this requirement. If the sponsor uses different language, the sponsor's language must fully satisfy the requirements of part 200. Select either "contractor" or "consultant" as applicable.

A3.3 CONTRACT CLAUSE

BREACH OF CONTRACT TERMS

Any violation or breach of terms of this contract on the part of the [*Contractor* | *Consultant*] or its subcontractors may result in the suspension or termination of this contract or such other action that may be necessary to enforce the rights of the parties of this agreement.

Owner will provide [*Contractor* | *Consultant*] written notice that describes the nature of the breach and corrective actions the [*Contractor* | *Consultant*] must undertake in order to avoid termination of the contract. Owner reserves the right to withhold payments to Contractor until such time the Contractor corrects the breach or the Owner elects to terminate the contract. The Owner's notice will identify a specific date by which the [*Contractor* | *Consultant*] must correct the breach. Owner may proceed with termination of the contract if the [*Contractor* | *Consultant*] fails to correct the breach by the deadline indicated in the Owner's notice.

The duties and obligations imposed by the Contract Documents and the rights and remedies available thereunder are in addition to, and not a limitation of, any duties, obligations, rights and remedies otherwise imposed or available by law.

A4 BUY AMERICAN PREFERENCE

A4.1 SOURCE

Title 49 USC § 50101

A4.2 APPLICABILITY

The Buy American Preference requirement in 49 USC § 50101 requires that all steel and manufactured goods used on AIP projects be produced in the United States. The statute gives the FAA the ability to issue a waiver to a sponsor to use non-domestic material on an AIP funded project subject to meeting certain conditions. A sponsor may request that the FAA issue a waiver from the Buy American Preference requirements if the FAA finds that:

- 1) Applying the provision is not in the public interest;
- 2) The steel or manufactured goods are not available in sufficient quantity or quality in the United States;
- 3) The cost of components and subcomponents produced in the United States is more than 60 percent of the total components of a facility or equipment, and final assembly has taken place in the United States. Items that have an FAA standard specification item number (such as specific airport lighting equipment) are considered the equipment.
- 4) Applying this provision would increase the cost of the overall project by more than 25 percent.

Timing of Waiver Requests. Sponsors desiring a Type 1 or Type 2 waiver must submit their waiver requests *before* issuing a solicitation for bids or a request for proposal for a project.

The sponsor must submit Type 3 or Type 4 waiver requests *prior* to executing the contract. The FAA will generally not consider waiver requests after execution of the contract except where extraordinary and extenuating circumstances exist. The FAA cannot review waiver requests with incomplete information. Sponsors must assess the adequacy of the waiver request and associated information prior to forwarding a waiver request to the FAA for action.

Buy American Conformance List. The FAA Office of Airports maintains a listing of equipment that has received a nationwide waiver from the Buy American Preference requirements or that fully meet the Buy American requirements. The Nationwide Buy American Waiver List is available online at www.faa.gov/airports/aip/buy_american/. Products listed on the Buy American Conformance list do not require additional submittal of domestic content information under a project specific Buy American Preference waiver.

Facility Waiver Requests. For construction of a facility, the sponsor may submit the waiver request after bid opening, but prior to contract execution. Examples of facility construction include terminal buildings, terminal renovation, and snow removal equipment buildings.

Contract Types –

Construction and Equipment – The sponsor must meet the Buy American Preference requirements of 49 USC § 50101 for all AIP funded projects that require steel or manufactured goods. The Buy America requirements flow down from the sponsor to first tier contractors, who are responsible for ensuring that lower tier contractors and subcontractors are also in compliance.

Note: The Buy American Preference does not apply to equipment a contractor uses as a tool of its trade and which does not remain as part of the project.

Professional Services – Professional service agreements (PSAs) do not normally result in a deliverable that meets the definition of a manufactured product. However, the emergence of various project delivery methods has created situations where task deliverables under a PSA may include a manufactured product. If a PSA includes providing a manufactured good as a deliverable under the contract, the sponsor must include the Buy American Preference provision in the agreement.

Property – Most land transactions do not involve acquiring a manufactured product. However, under certain circumstances, a property acquisition project could result in the installation of a manufactured product. For example, the installation of property fencing, gates, doors and locks, etc. represent manufactured products acquired under an AIP funded land project that must comply with Buy American Preferences.

Use of Provision – No mandatory language provided. The following language is acceptable to the FAA and meets the intent of this requirement. If the sponsor uses different language, the sponsor’s revised language must fully comply with 49 USC § 50101.

There are two types of Buy American certifications. The sponsor must incorporate the appropriate “Certificate of Buy America Compliance” in the solicitation:

- Projects for a facility (buildings such as terminals, snow removal equipment (SRE) buildings, aircraft rescue and firefighting (ARFF) buildings, etc.) – Insert the Certificate of Compliance Based on Total Facility.
- Projects for non-facility development (non-building construction projects such as runway or roadway construction or equipment acquisition projects) – Insert the Certificate of Compliance Based on Equipment and Materials Used on the Project.

A4.3 SOLICITATION CLAUSE

A4.3.1 Buy American Preference Statement

BUY AMERICAN PREFERENCE

The Contractor agrees to comply with 49 USC § 50101, which provides that Federal funds may not be obligated unless all steel and manufactured goods used in AIP funded projects are produced in the United States, unless the Federal Aviation Administration has issued a waiver for the product; the product is listed as an Excepted Article, Material Or Supply in Federal Acquisition Regulation subpart 25.108; or is included in the FAA Nationwide Buy American Waivers Issued list.

A bidder or offeror must complete and submit the Buy America certification included herein with their bid or offer. The Owner will reject as nonresponsive any bid or offer that does not include a completed Certificate of Buy American Compliance.

A4.3.2 Certificate of Buy American Compliance – Total Facility

CERTIFICATE OF BUY AMERICAN COMPLIANCE FOR TOTAL FACILITY

As a matter of bid responsiveness, the bidder or offeror must complete, sign, date, and submit this certification statement with its proposal. The bidder or offeror must indicate how it intends to comply with 49 USC § 50101 by selecting one of the following certification statements. These statements are mutually exclusive. Bidder must select one or the other (i.e. not both) by inserting a checkmark (✓) or the letter “X”.

- ☐ Bidder or offeror hereby certifies that it will comply with 49 USC § 50101 by:
- a) Only installing steel and manufactured products produced in the United States; or
 - b) Installing manufactured products for which the Federal Aviation Administration (FAA) has issued a waiver as indicated by inclusion on the current FAA Nationwide Buy American Waivers Issued listing; or
 - c) Installing products listed as an Excepted Article, Material or Supply in Federal Acquisition Regulation Subpart 25.108.

By selecting this certification statement, the bidder or offeror agrees:

- To provide to the Owner evidence that documents the source and origin of the steel and manufactured product.
- To faithfully comply with providing U.S. domestic products.
- To refrain from seeking a waiver request after establishment of the contract, unless extenuating circumstances emerge that the FAA determines justified.

- ☐ The bidder or offeror hereby certifies it cannot comply with the 100 percent Buy American Preferences of 49 USC § 50101(a) but may qualify for either a Type 3 or Type 4 waiver under 49 USC § 50101(b). By selecting this certification statement, the apparent bidder or offeror with the apparent low bid agrees:

- a) To submit to the Owner within 15 calendar days of the bid opening, a formal waiver request and required documentation that supports the type of waiver being requested.
- b) That failure to submit the required documentation within the specified timeframe is cause for a non-responsive determination that may result in rejection of the proposal.
- c) To faithfully comply with providing U.S. domestic products at or above the approved U.S. domestic content percentage as approved by the FAA.
- d) To furnish U.S. domestic product for any waiver request that the FAA rejects.
- e) To refrain from seeking a waiver request after establishment of the contract, unless extenuating circumstances emerge that the FAA determines justified.

Required Documentation

Type 3 Waiver – The cost of components and subcomponents produced in the United States is more than 60 percent of the cost of all components and subcomponents of the “facility”. The required documentation for a Type 3 waiver is:

- a) Listing of all manufactured products that are not comprised of 100 percent U.S. domestic content (excludes products listed on the FAA Nationwide Buy American Waivers Issued listing and products excluded by Federal Acquisition Regulation Subpart 25.108; products of unknown origin must be considered as non-domestic products in their entirety).

- b) Cost of non-domestic components and subcomponents, excluding labor costs associated with final assembly and installation at project location.
- c) Percentage of non-domestic component and subcomponent cost as compared to total “facility” component and subcomponent costs, excluding labor costs associated with final assembly and installation at project location.

Type 4 Waiver – Total cost of project using U.S. domestic source product exceeds the total project cost using non-domestic product by 25 percent. The required documentation for a Type 4 of waiver is:

- a) Detailed cost information for total project using U.S. domestic product
- b) Detailed cost information for total project using non-domestic product

False Statements: Per 49 USC § 47126, this certification concerns a matter within the jurisdiction of the Federal Aviation Administration and the making of a false, fictitious or fraudulent certification may render the maker subject to prosecution under Title 18, United States Code.

Date

Signature

Company Name

Title

A4.3.3 Certificate of Buy American Compliance – Manufactured Product

Certificate of Buy American Compliance for Manufactured Products

As a matter of bid responsiveness, the bidder or offeror must complete, sign, date, and submit this certification statement with their proposal. The bidder or offeror must indicate how they intend to comply with 49 USC § 50101 by selecting one on the following certification statements. These statements are mutually exclusive. Bidder must select one or the other (not both) by inserting a checkmark (✓) or the letter “X”.

- ☐ Bidder or offeror hereby certifies that it will comply with 49 USC § 50101 by:
- a) Only installing steel and manufactured products produced in the United States;
 - b) Installing manufactured products for which the Federal Aviation Administration (FAA) has issued a waiver as indicated by inclusion on the current FAA Nationwide Buy American Waivers Issued listing; or
 - c) Installing products listed as an Excepted Article, Material or Supply in Federal Acquisition Regulation Subpart 25.108.

By selecting this certification statement, the bidder or offeror agrees:

1. To provide to the Owner evidence that documents the source and origin of the steel and manufactured product.
2. To faithfully comply with providing U.S. domestic product.
3. To furnish U.S. domestic product for any waiver request that the FAA rejects
4. To refrain from seeking a waiver request after establishment of the contract, unless extenuating circumstances emerge that the FAA determines justified.

- ☐ The bidder or offeror hereby certifies it cannot comply with the 100 percent Buy American Preferences of 49 USC § 50101(a) but may qualify for either a Type 3 or Type 4 waiver under 49 USC § 50101(b). By selecting this certification statement, the apparent bidder or offeror with the apparent low bid agrees:

1. To submit to the Owner within 15 calendar days of the bid opening, a formal waiver request and required documentation that supports the type of waiver being requested.
2. That failure to submit the required documentation within the specified timeframe is cause for a non-responsive determination may result in rejection of the proposal.
3. To faithfully comply with providing U.S. domestic products at or above the approved U.S. domestic content percentage as approved by the FAA.
4. To refrain from seeking a waiver request after establishment of the contract, unless extenuating circumstances emerge that the FAA determines justified.

Required Documentation

Type 3 Waiver – The cost of the item components and subcomponents produced in the United States is more than 60 percent of the cost of all components and subcomponents of the “item”. The required documentation for a Type 3 waiver is:

- a) Listing of all product components and subcomponents that are not comprised of 100 percent U.S. domestic content (Excludes products listed on the FAA Nationwide Buy American Waivers Issued listing and products excluded by Federal Acquisition Regulation Subpart 25.108; products of unknown origin must be considered as non-domestic products in their entirety).
- b) Cost of non-domestic components and subcomponents, excluding labor costs associated with final assembly at place of manufacture.
- c) Percentage of non-domestic component and subcomponent cost as compared to total “item” component and subcomponent costs, excluding labor costs associated with final assembly at place of manufacture.

Type 4 Waiver – Total cost of project using U.S. domestic source product exceeds the total project cost using non-domestic product by 25 percent. The required documentation for a Type 4 of waiver is:

- a) Detailed cost information for total project using U.S. domestic product
- b) Detailed cost information for total project using non-domestic product

False Statements: Per 49 USC § 47126, this certification concerns a matter within the jurisdiction of the Federal Aviation Administration and the making of a false, fictitious or fraudulent certification may render the maker subject to prosecution under Title 18, United States Code.

Date

Signature

Company Name

Title

A5 CIVIL RIGHTS - GENERAL

A5.1 SOURCE

49 USC § 47123

A5.2 APPLICABILITY

There are two separate civil rights provisions that apply to projects:

1. FAA General Civil Rights Provision and,
2. Title VI provisions, which are addressed in Appendix A6.

Contract Types – The General Civil Rights Provisions found in 49 USC § 47123, derived from the Airport and Airway Improvement Act of 1982, Section 520, apply to all sponsor contracts *regardless* of funding source.

Use of Provision – MANDATORY TEXT. There are two separate general civil rights provisions—one that is used for contracts, and one that is used for lease agreements or transfer agreements. The sponsor must incorporate the text of the appropriate provision without modification into the contract, or the lease or transfer agreement.

A5.3 CONTRACT CLAUSE (Use the Correct Clause for the Situation)

A5.3.1 Clause that is used for Contracts

GENERAL CIVIL RIGHTS PROVISIONS

The Contractor agrees to comply with pertinent statutes, Executive Orders and such rules as are promulgated to ensure that no person shall, on the grounds of race, creed, color, national origin, sex, age, or disability be excluded from participating in any activity conducted with or benefiting from Federal assistance.

This provision binds the Contractor and subcontractors from the bid solicitation period through the completion of the contract. This provision is in addition to that required by Title VI of the Civil Rights Act of 1964.

A5.3.2 Clause that is used for Lease Agreements or Transfer Agreements

GENERAL CIVIL RIGHTS PROVISIONS

The (tenant/concessionaire/lessee) agrees to comply with pertinent statutes, Executive Orders and such rules as are promulgated to ensure that no person shall, on the grounds of race, creed, color, national origin, sex, age, or disability be excluded from participating in any activity conducted with or benefiting from Federal assistance. If the (tenant/concessionaire/lessee) transfers its obligation to another, the transferee is obligated in the same manner as the (tenant/concessionaire/lessor).

This provision obligates the (tenant/concessionaire/lessee) for the period during which the property is owned, used or possessed by the (tenant/concessionaire/lessee) and the airport remains obligated to the

Federal Aviation Administration. This provision is in addition to that required by Title VI of the Civil Rights Act of 1964.

A6 CIVIL RIGHTS – TITLE VI ASSURANCE

A6.1 SOURCE

49 USC § 47123

FAA Order 1400.11

A6.2 APPLICABILITY

Title VI of the Civil Rights Act of 1964, as amended, (Title VI) prohibits discrimination on the grounds of race, color, or national origin under any program or activity receiving Federal financial assistance. Sponsors must include appropriate clauses from the Standard DOT Title VI Assurances in all contracts and solicitations.

The text of each individual clause comes from the U.S. Department of Transportation [Order DOT 1050.2](#), Standard Title VI Assurances and Nondiscrimination Provisions, effective April 24, 2013. These assurances require that the Recipient (the sponsor) insert the appropriate clauses in the form provided by the DOT. Where the clause refers to the applicable activity, project, or program, it means the AIP project.

The clauses are as follows:

A6.2.1 Applicability of Title VI Solicitation Notice

Contract Clause	The Sponsor must include the contract clause in:	Clause Text is Included in Paragraph
Title VI Solicitation Notice – - Assurance 2 of the DOT Standard Title VI Assurances and Nondiscrimination Clauses - Assurance 30d of the Airport Sponsor Assurances	1) All AIP funded solicitations for bids, requests for proposals, or any work subject to Title VI regulations; and 2) All sponsor proposals for negotiated agreements regardless of funding source.	A6.3.1
Title VI Clauses for Compliance with Nondiscrimination Requirements - Assurance 3 of the DOT Standard Title VI Assurances and Nondiscrimination Clauses - Assurance 30e.1 of the Airport Sponsor Assurances	Every contract or agreement (unless the sponsor has determined, and the FAA concurs, that the contract or agreement is not subject to the Nondiscrimination Acts and Authorities) It has been determined that service contracts with utility companies that are not already subject to nondiscrimination requirements must include this clause.	A6.4.1

Contract Clause	The Sponsor must include the contract clause in:	Clause Text is Included in Paragraph
Title VI Required Clause for Property Interests Transferred from the United States - Assurance 4 of the DOT Standard Title VI Assurances and Nondiscrimination Clauses - Assurance 30e.3 of the Airport Sponsor Assurances	As a covenant running with the land, in any deed from the United States effecting or recording a transfer of real property, structures, use, or improvements thereon or interest therein to a sponsor. This is a rare occurrence and it will be the responsibility of the United States government to include the clause in the contract.	A6.4.2
Title VI Required Clause for Transfer of Real Property Acquired or Improved Under the Activity, Facility or Program – - Assurance 5 of the DOT Standard Title VI Assurances and Nondiscrimination Clauses - Assurance 30e.4a of the Airport Sponsor Assurances	As a covenant running with the land, in any future deeds, leases, licenses, permits, or similar instruments entered into by the sponsor with other parties for all transfers of real property acquired or improved under Airport Improvement Program This applies to agreements such as leases where a physical portion of the airport is transferred for use, for example a fuel farm, apron space, or a parking facility.	A6.4.3
Clause for Construction/Use/Access to Real Property Acquired Under the Activity, Facility or Program - Assurance 6 of the DOT Standard Title VI Assurances and Nondiscrimination Clauses - Assurance 30e.4b of the Airport Sponsor Assurances	In any future (deeds, leases, licenses, permits, or similar instruments) entered into by the sponsor with other parties for the construction or use of, or access to, space on, over, or under real property acquired or improved under Airport Improvement Program This applies to agreements such as leases of concession space in a terminal.	A6.4.4
Title VI List of Pertinent Nondiscrimination Acts and Authorities - Assurance 3 of the DOT Standard Title VI Assurances and Nondiscrimination Clauses - Assurance 30e.2 of the Airport Sponsor Assurances	Insert this list in every contract or agreement, unless the sponsor has determined, and the FAA concurs, that the contract or agreement is not subject to the Nondiscrimination Acts and Authorities. This list can be omitted if the FAA has determined that the contractor or company is already subject to nondiscrimination requirements.	A6.4.5

A6.3 SOLICITATION CLAUSE

The sponsor must include this clause in:

- 1) All AIP funded solicitations for bids, requests for proposals, or any work subject to Title VI regulations; and
- 2) All sponsor proposals for negotiated agreements **regardless of funding source.**

A6.3.1 Title VI Solicitation Notice

Title VI Solicitation Notice:

The **(Name of Sponsor)**, in accordance with the provisions of Title VI of the Civil Rights Act of 1964 (78 Stat. 252, 42 USC §§ 2000d to 2000d-4) and the Regulations, hereby notifies all bidders or offerors that it will affirmatively ensure that any contract entered into pursuant to this advertisement, [select disadvantaged business enterprises or airport concession disadvantaged business enterprises] will be afforded full and fair opportunity to submit bids in response to this invitation and will not be discriminated against on the grounds of race, color, or national origin in consideration for an award.

A6.4 CONTRACT CLAUSES

A6.4.1 Title VI Clauses for Compliance with Nondiscrimination Requirements

The sponsor must include this contract clause in:

- 1) Every contract or agreement (unless the sponsor has determined, and the FAA concurs, that the contract or agreement is not subject to the Nondiscrimination Acts and Authorities); and
- 2) Service contracts with utility companies that are not already subject to nondiscrimination requirements.

Compliance with Nondiscrimination Requirements:

During the performance of this contract, the Contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the “Contractor”), agrees as follows:

1. **Compliance with Regulations:** The Contractor (hereinafter includes consultants) will comply with the Title VI List of Pertinent Nondiscrimination Acts and Authorities, as they may be amended from time to time, which are herein incorporated by reference and made a part of this contract.
2. **Nondiscrimination:** The Contractor, with regard to the work performed by it during the contract, will not discriminate on the grounds of race, color, or national origin in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The Contractor will not participate directly or indirectly in the discrimination prohibited by the Nondiscrimination Acts and Authorities, including employment practices when the contract covers any activity, project, or program set forth in Appendix B of 49 CFR part 21.
3. **Solicitations for Subcontracts, including Procurements of Materials and Equipment:** In all solicitations, either by competitive bidding or negotiation made by the Contractor for work to be performed under a subcontract, including procurements of materials, or leases of equipment, each potential subcontractor or supplier will be notified by the Contractor of the contractor’s obligations under this contract and the Nondiscrimination Acts and Authorities on the grounds of race, color, or national origin.
4. **Information and Reports:** The Contractor will provide all information and reports required by the Acts, the Regulations, and directives issued pursuant thereto and will permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by the sponsor or the Federal Aviation Administration to be pertinent to ascertain compliance with such Nondiscrimination Acts and Authorities and instructions. Where any information required of a contractor is in the exclusive possession of another who fails or refuses to furnish the information, the Contractor will so certify to the sponsor or the Federal Aviation Administration, as appropriate, and will set forth what efforts it has made to obtain the information.
5. **Sanctions for Noncompliance:** In the event of a Contractor’s noncompliance with the non-discrimination provisions of this contract, the sponsor will impose such contract sanctions as it or the Federal Aviation Administration may determine to be appropriate, including, but not limited to:
 - a. Withholding payments to the Contractor under the contract until the Contractor complies; and/or

- b. Cancelling, terminating, or suspending a contract, in whole or in part.
6. **Incorporation of Provisions:** The Contractor will include the provisions of paragraphs one through six in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Acts, the Regulations, and directives issued pursuant thereto. The Contractor will take action with respect to any subcontract or procurement as the sponsor or the Federal Aviation Administration may direct as a means of enforcing such provisions including sanctions for noncompliance. Provided, that if the Contractor becomes involved in, or is threatened with litigation by a subcontractor, or supplier because of such direction, the Contractor may request the sponsor to enter into any litigation to protect the interests of the sponsor. In addition, the Contractor may request the United States to enter into the litigation to protect the interests of the United States.

A6.4.2 Title VI Clauses for Deeds Transferring United States Property

This is a rare occurrence, and it will be the responsibility of the United States government to include the clause in the contract. It will be included as a covenant running with the land, in any deed from the United States effecting or recording a transfer of real property, structures, use, or improvements thereon or interest therein to a sponsor.

CLAUSES FOR DEEDS TRANSFERRING UNITED STATES PROPERTY

The following clauses will be included in deeds effecting or recording the transfer of real property, structures, or improvements thereon, or granting interest therein from the United States pursuant to the provisions of the Airport Improvement Program grant assurances.

NOW, THEREFORE, the Federal Aviation Administration as authorized by law and upon the condition that the SAVANNAH AIRPORT COMMISSION will accept title to the lands and maintain the project constructed thereon in accordance with CITY OF SAVANNAH, COUNTY OF CHATHAM, STATE OF GEORGIA, for the **(Airport Improvement Program or other program for which land is transferred)**, and the policies and procedures prescribed by the Federal Aviation Administration of the U.S. Department of Transportation in accordance and in compliance with all requirements imposed by Title 49, Code of Federal Regulations, U.S. Department of Transportation, Subtitle A, Office of the Secretary, Part 21, Non-discrimination in Federally-assisted programs of the U.S. Department of Transportation pertaining to and effectuating the provisions of Title VI of the Civil Rights Act of 1964 (78 Stat. 252; 42 USC § 2000d to 2000d-4), does hereby remise, release, quitclaim and convey unto the SAVANNAH AIRPORT COMMISSION all the right, title and interest of the U.S. Department of Transportation/Federal Aviation Administration in and to said lands described in *(Exhibit A attached hereto or other exhibit describing the transferred property)* and made a part hereof.

(HABENDUM CLAUSE)

TO HAVE AND TO HOLD said lands and interests therein unto SAVANNAH AIRPORT COMMISSION and its successors forever, subject, however, to the covenants, conditions, restrictions and reservations herein contained as follows, which will remain in effect for the period during which the real property or structures are used for a purpose for which Federal financial assistance is extended or for another purpose involving the provision of similar services or benefits and will be binding on the SAVANNAH AIRPORT COMMISSION, its successors and assigns.

THE SAVANNAH AIRPORT COMMISSION, in consideration of the conveyance of said lands and interests in lands, does hereby covenant and agree as a covenant running with the land for itself, its successors and assigns, that (1) no person will on the grounds of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination

with regard to any facility located wholly or in part on, over, or under such lands hereby conveyed [,] [and]* (2) that the SAVANNAH AIRPORT COMMISSION will use the lands and interests in lands and interests in lands so conveyed, in compliance with all requirements imposed by or pursuant to Title 49, Code of Federal Regulations, U.S. Department of Transportation, Subtitle A, Office of the Secretary, Part 21, Non-discrimination in Federally-assisted programs of the U.S. Department of Transportation, Effectuation of Title VI of the Civil Rights Act of 1964, and as said Regulations and Acts may be amended[, and (3) that in the event of breach of any of the above-mentioned nondiscrimination conditions, the Department will have a right to enter or re-enter said lands and facilities on said land, and that above described land and facilities will thereon revert to and vest in and become the absolute property of the Federal Aviation Administration and its assigns as such interest existed prior to this instruction].*

(*Reverter clause and related language to be used only when it is determined that such a clause is necessary in order to make clear the purpose of Title VI.)

A6.4.3 Title VI Clauses for Transfer of Real Property Acquired or Improved Under the Activity, Facility, or Program

This applies to agreements such as leases where a physical portion of the airport is transferred for use—for example a fuel farm, apron space, or a parking facility—and will be included as a covenant running with the land, in any future deeds, leases, licenses, permits, or similar instruments entered into by the sponsor with other parties for all transfers of real property acquired or improved under the Airport Improvement Program.

CLAUSES FOR TRANSFER OF REAL PROPERTY ACQUIRED OR IMPROVED UNDER THE AIRPORT IMPROVEMENT PROGRAM

The following clauses will be included in (deeds, licenses, leases, permits, or similar instruments) entered into by the SAVANNAH AIRPORT COMMISSION pursuant to the provisions of the Airport Improvement Program grant assurances.

- A. The (grantee, lessee, permittee, etc. as appropriate) for himself/herself, his/her heirs, personal representatives, successors in interest, and assigns, as a part of the consideration hereof, does hereby covenant and agree [in the case of deeds and leases add “as a covenant running with the land”] that:
 - 1. In the event facilities are constructed, maintained, or otherwise operated on the property described in this (deed, license, lease, permit, etc.) for a purpose for which a Federal Aviation Administration activity, facility, or program is extended or for another purpose involving the provision of similar services or benefits, the (grantee, licensee, lessee, permittee, etc.) will maintain and operate such facilities and services in compliance with all requirements imposed by the Nondiscrimination Acts and Regulations listed in the Pertinent List of Nondiscrimination Authorities (as may be amended) such that no person on the grounds of race, color, or national origin, will be excluded from participation in, denied the benefits of, or be otherwise subjected to discrimination in the use of said facilities.
- B. With respect to licenses, leases, permits, etc., in the event of breach of any of the above Nondiscrimination covenants, SAVANNAH AIRPORT COMMISSION will have the right to terminate the (lease, license, permit, etc.) and to enter, re-enter, and repossess said lands and facilities thereon, and hold the same as if the (lease, license, permit, etc.) had never been made or issued.*

- C. With respect to a deed, in the event of breach of any of the above Nondiscrimination covenants, THE SAVANNAH AIRPORT COMMISSION will have the right to enter or re-enter the lands and facilities thereon, and the above described lands and facilities will there upon revert to and vest in and become the absolute property of the SAVANNAH AIRPORT COMMISSION and its assigns.*

(*Reverter clause and related language to be used only when it is determined that such a clause is necessary to make clear the purpose of Title VI.)

A6.4.4 Title VI Clauses for Construction/Use/Access to Real Property Acquired Under the Activity, Facility or Program

This applies to agreements such as leases of concession space in a terminal and any future deeds, leases, licenses, permits, or similar instruments entered into by the sponsor with other parties for the construction or use of, or access to, space on, over, or under real property acquired or improved under the Airport Improvement Program.

CLAUSES FOR CONSTRUCTION/USE/ACCESS TO REAL PROPERTY ACQUIRED UNDER THE ACTIVITY, FACILITY OR PROGRAM

The following clauses will be included in deeds, licenses, permits, or similar instruments/agreements entered into by SAVANNAH AIRPORT COMMISSION pursuant to the provisions of the Airport Improvement Program grant assurances.

- A. The (grantee, licensee, permittee, etc., as appropriate) for himself/herself, his/her heirs, personal representatives, successors in interest, and assigns, as a part of the consideration hereof, does hereby covenant and agree (in the case of deeds and leases add, “as a covenant running with the land”) that (1) no person on the ground of race, color, or national origin, will be excluded from participation in, denied the benefits of, or be otherwise subjected to discrimination in the use of said facilities, (2) that in the construction of any improvements on, over, or under such land, and the furnishing of services thereon, no person on the ground of race, color, or national origin, will be excluded from participation in, denied the benefits of, or otherwise be subjected to discrimination, (3) that the (grantee, licensee, lessee, permittee, etc.) will use the premises in compliance with all other requirements imposed by or pursuant to the List of discrimination Acts And Authorities.
- B. With respect to (licenses, leases, permits, etc.), in the event of breach of any of the above nondiscrimination covenants, SAVANNAH AIRPORT COMMISSION will have the right to terminate the (license, permit, etc., as appropriate) and to enter or re-enter and repossess said land and the facilities thereon, and hold the same as if said (license, permit, etc., as appropriate) had never been made or issued.*
- C. With respect to deeds, in the event of breach of any of the above nondiscrimination covenants, SAVANNAH AIRPORT COMMISSION will there upon revert to and vest in and become the absolute property of SAVANNAH AIRPORT COMMISSION and its assigns.*

(*Reverter clause and related language to be used only when it is determined that such a clause is necessary to make clear the purpose of Title VI.)

A6.4.5 Title VI List of Pertinent Nondiscrimination Acts and Authorities

Insert this list in every contract or agreement, unless the sponsor has determined and the FAA concurs, that the contract or agreement is not subject to the Nondiscrimination Acts and Authorities. This list can be omitted if the FAA has determined that the contractor or company is already subject to nondiscrimination requirements.

Title VI List of Pertinent Nondiscrimination Acts and Authorities

During the performance of this contract, the Contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the “Contractor”) agrees to comply with the following non-discrimination statutes and authorities; including but not limited to:

- Title VI of the Civil Rights Act of 1964 (42 USC § 2000d *et seq.*, 78 stat. 252) (prohibits discrimination on the basis of race, color, national origin);
- 49 CFR part 21 (Non-discrimination in Federally-assisted programs of the Department of Transportation—Effectuation of Title VI of the Civil Rights Act of 1964);
- The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, (42 USC § 4601) (prohibits unfair treatment of persons displaced or whose property has been acquired because of Federal or Federal-aid programs and projects);
- Section 504 of the Rehabilitation Act of 1973 (29 USC § 794 *et seq.*), as amended (prohibits discrimination on the basis of disability); and 49 CFR part 27;
- The Age Discrimination Act of 1975, as amended (42 USC § 6101 *et seq.*) (prohibits discrimination on the basis of age);
- Airport and Airway Improvement Act of 1982 (49 USC § 471, Section 47123), as amended (prohibits discrimination based on race, creed, color, national origin, or sex);
- The Civil Rights Restoration Act of 1987 (PL 100-209) (broadened the scope, coverage and applicability of Title VI of the Civil Rights Act of 1964, the Age Discrimination Act of 1975 and Section 504 of the Rehabilitation Act of 1973, by expanding the definition of the terms “programs or activities” to include all of the programs or activities of the Federal-aid recipients, sub-recipients and contractors, whether such programs or activities are Federally funded or not);
- Titles II and III of the Americans with Disabilities Act of 1990, which prohibit discrimination on the basis of disability in the operation of public entities, public and private transportation systems, places of public accommodation, and certain testing entities (42 USC §§ 12131 – 12189) as implemented by U.S. Department of Transportation regulations at 49 CFR parts 37 and 38;
- The Federal Aviation Administration’s Nondiscrimination statute (49 USC § 47123) (prohibits discrimination on the basis of race, color, national origin, and sex);
- Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, which ensures nondiscrimination against minority populations by discouraging programs, policies, and activities with disproportionately high and adverse human health or environmental effects on minority and low-income populations;
- Executive Order 13166, Improving Access to Services for Persons with Limited English Proficiency, and resulting agency guidance, national origin discrimination includes discrimination because of limited English proficiency (LEP). To ensure compliance with Title VI, you must take reasonable steps to ensure that LEP persons have meaningful access to your programs (70 Fed. Reg. at 74087 to 74100);

- Title IX of the Education Amendments of 1972, as amended, which prohibits you from discriminating because of sex in education programs or activities (20 USC 1681 et seq).

A7 CLEAN AIR AND WATER POLLUTION CONTROL

A7.1 SOURCE

2 CFR § 200, Appendix II(G)

A7.2 APPLICABILITY

Contract Types – This provision is required for all contracts and lower tier contracts that exceed \$150,000.

Use of Provision – No mandatory language provided. The following language is acceptable to the FAA and meets the intent of this requirement. If the sponsor uses different language, the sponsor's language must fully satisfy the requirements of Appendix II to 2 CFR §200.

A7.3 CONTRACT CLAUSE

CLEAN AIR AND WATER POLLUTION CONTROL

Contractor agrees to comply with all applicable standards, orders, and regulations issued pursuant to the Clean Air Act (42 USC § 740-7671q) and the Federal Water Pollution Control Act as amended (33 USC § 1251-1387). The Contractor agrees to report any violation to the Owner immediately upon discovery. The Owner assumes responsibility for notifying the Environmental Protection Agency (EPA) and the Federal Aviation Administration.

Contractor must include this requirement in all subcontracts that exceeds \$150,000.

A8 CONTRACT WORKHOURS AND SAFETY STANDARDS ACT REQUIREMENTS

A8.1 SOURCE

2 CFR § 200, Appendix II(E)

A8.2 APPLICABILITY

Contract Workhours and Safety Standards Act Requirements (CWHSSA) requires contractors and subcontractors on covered contracts to pay laborers and mechanics employed in the performance of the contracts one and one-half times their basic rate of pay for all hours worked over 40 in a workweek. CWHSSA prohibits unsanitary, hazardous, or dangerous working conditions on federally assisted projects. The Wage and Hour Division (WHD) within the U.S. Department of Labor (DOL) enforces the compensation requirements of this Act, while DOL's Occupational Safety and Health Administration (OSHA) enforces the safety and health requirements

Contract Types –

Construction – This provision applies to all contracts and lower tier contracts that exceed \$100,000, and employ laborers, mechanics, watchmen, and guards.

Equipment – This provision applies to any equipment project exceeding \$100,000 that involves installation of equipment onsite (e.g. electrical vault equipment). This provision does not apply to equipment acquisition projects where the manufacture of the equipment takes place offsite at the vendor plant (e.g. ARFF and SRE vehicles).

Professional Services – This provision applies to professional service agreements that exceed \$100,000 and employs laborers, mechanics, watchmen, and guards. This includes members of survey crews and exploratory drilling operations.

Property – While most land transactions do not involve employment of laborers, mechanics, watchmen, and guards, under certain circumstances, a property acquisition project could require such employment. Examples include the installation of property fencing or testing for environmental contamination

Use of Provision – MANDATORY TEXT. Sponsors must incorporate this text without modification.

A8.3 CONTRACT CLAUSE

CONTRACT WORKHOURS AND SAFETY STANDARDS ACT REQUIREMENTS

1. Overtime Requirements.

No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic, including watchmen and guards, in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

2. Violation; Liability for Unpaid Wages; Liquidated Damages.

In the event of any violation of the clause set forth in paragraph (1) of this clause, the Contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (1) of this clause, in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (1) of this clause.

3. Withholding for Unpaid Wages and Liquidated Damages.

The Federal Aviation Administration (FAA) or the Owner shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (2) of this clause.

4. Subcontractors.

The Contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraphs (1) through (4) and also a clause requiring the subcontractor to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (1) through (4) of this clause.

A9 COPELAND “ANTI-KICKBACK” ACT

A9.1 SOURCE

2 CFR § 200, Appendix II(D)

29 CFR Parts 3 and 5

A9.2 APPLICABILITY and PURPOSE

The Copeland (Anti-Kickback) Act (18 USC 874 and 40 USC 3145) makes it unlawful to induce by force, intimidation, threat of dismissal from employment, or by any other manner, any person employed in the construction or repair of public buildings or public works, financed in whole or in part by the United States, to give up any part of the compensation to which that person is entitled under a contract of employment. The Copeland Act also requires each contractor and subcontractor to furnish weekly a statement of compliance with respect to the wages paid each employee during the preceding week.

Contract Types –

Construction – This provision applies to all construction contracts and subcontracts financed under the AIP that exceed \$2,000.

Equipment – This provision applies to all equipment installation projects (e.g. electrical vault improvements) financed under the AIP that exceed \$2,000. This provision does not apply to equipment acquisitions where the equipment is manufactured at the vendor’s plant (e.g. SRE and ARFF vehicles).

Professional Services –The emergence of different project delivery methods has created situations where Professional Service Agreements (PSAs) include tasks that meet the definition of construction, alteration, or repair as defined in 29 CFR Part 5. If such tasks result in work that qualifies as construction, alteration, or repair and it exceeds \$2,000, the PSA must incorporate the Copeland Anti-kickback provision.

Property –Ordinarily, land acquisition projects would not involve employment of laborers or mechanics and thus the Copeland Anti-Kickback provision would not apply. However, land projects that involve installation of boundary fencing and demolition of structures would involve laborers and mechanics. The sponsor must include this provision if the land acquisition project involves employment of laborers or mechanics for a contract exceeding \$2,000.

Use of Provision – MANDATORY TEXT. 29 CFR Part 5 establishes specific language a sponsor must use in construction contracts. The sponsor may not make any modification to the standard language. Architectural/Engineering (A/E) firms that employ laborers and mechanics on a task that meets the definition of construction, alteration, or repair are acting as a contractor. The sponsor may not substitute the term “contractor” for “consultant” in such instances.

A9.3 CONTRACT CLAUSE

COPELAND “ANTI-KICKBACK” ACT

Contractor must comply with the requirements of the Copeland “Anti-Kickback” Act (18 USC 874 and 40 USC 3145), as supplemented by Department of Labor regulation 29 CFR part 3. Contractor and subcontractors are prohibited from inducing, by any means, any person employed on the project to give up any part of the compensation to which the employee is entitled. The Contractor and each Subcontractor must submit to the Owner, a weekly statement on the wages paid to each employee performing on covered work during the prior week. Owner must report any violations of the Act to the Federal Aviation Administration.

A10 DAVIS-BACON REQUIREMENTS

A10.1 SOURCE

2 CFR § 200, Appendix II(D)

29 CFR Part 5

A10.2 APPLICABILITY

The Davis-Bacon Act ensures that laborers and mechanics employed under the contract receive pay no less than the locally prevailing wages and fringe benefits as determined by the Department of Labor.

Contract Types –

Construction – Incorporate into all construction contracts and subcontracts that exceed \$2,000 and include funding from the AIP.

Equipment – This provision applies to all equipment installation projects (e.g. electrical vault improvements) financed under the AIP that exceed \$ 2, 000. This provision does not apply to equipment acquisitions where the equipment is manufactured at the vendor’s plant (e.g. SRE and ARFF vehicles)

Professional Services – The emergence of different project delivery methods has created situations where Professional Service Agreements (PSAs) includes tasks that meet the definition of construction, alteration, or repair as defined in 29 CFR Part 5. If such tasks result in work that qualifies as construction, alteration, or repair and it exceeds \$2,000, the PSA must incorporate this clause.

Property – Ordinarily, land acquisition projects would not involve employment of laborers or mechanics and thus the provision would not apply. However, land projects that involve installation of boundary fencing and demolition of structures would involve laborers and mechanics. The sponsor must include this provision if the land acquisition project involves employment of laborers or mechanics for a contract exceeding \$2,000.

Fencing Projects – Fencing projects that exceed \$2,000 must include this provision.

Use of Provision – MANDATORY TEXT. 29 CFR part 5 establishes specific language a sponsor must use. The sponsor may not make any modification to the standard language. A/E firms that employ laborers and mechanics on a task that meets the definition of construction, alteration, or repair are acting as a contractor. The sponsor may not substitute the term “Contractor” for “Consultant” in such instances.

A10.3 CONTRACT CLAUSE

DAVIS-BACON REQUIREMENTS

1. Minimum Wages.

(i) All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by the Secretary of Labor under the Copeland Act (29 CFR Part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalent

thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the Contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in 29 CFR Part 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: *Provided* that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under (1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the Contractor and its subcontractors at the site of the work in a prominent and accessible place where it can easily be seen by the workers.

(ii)(A) The contracting officer shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The contracting officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

- (1) The work to be performed by the classification requested is not performed by a classification in the wage determination;
- (2) The classification is utilized in the area by the construction industry; and
- (3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(B) If the Contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(C) In the event the Contractor, the laborers, or mechanics to be employed in the classification, or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Administrator for determination. The Administrator, or an authorized

representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to subparagraphs (1)(ii) (B) or (C) of this paragraph, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the Contractor does not make payments to a trustee or other third person, the Contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program: *Provided* that the Secretary of Labor has found, upon the written request of the Contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the Contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

2. Withholding.

The Federal Aviation Administration or the sponsor shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld from the Contractor under this contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the Contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of work, all or part of the wages required by the contract, the Federal Aviation Administration may, after written notice to the Contractor, Sponsor, Applicant, or Owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

3. Payrolls and Basic Records.

(i) Payrolls and basic records relating thereto shall be maintained by the Contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker; his or her correct classification; hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in 1(b)(2)(B) of the Davis-Bacon Act); daily and weekly number of hours worked; deductions made; and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the Contractor shall maintain records that show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and that show the costs anticipated or

the actual costs incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii)(A) The Contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the Federal Aviation Administration if the agency is a party to the contract, but if the agency is not such a party, the Contractor will submit the payrolls to the applicant, Sponsor, or Owner, as the case may be, for transmission to the Federal Aviation Administration. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the payrolls shall only need to include an individually identifying number for each employee (*e.g.* the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at www.dol.gov/whd/forms/wh347instr.htm or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker and shall provide them upon request to the Federal Aviation Administration if the agency is a party to the contract, but if the agency is not such a party, the Contractor will submit them to the applicant, sponsor, or Owner, as the case may be, for transmission to the Federal Aviation Administration, the Contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the sponsoring government agency (or the applicant, Sponsor, or Owner).

(B) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the Contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) The payroll for the payroll period contains the information required to be provided under 29 CFR § 5.5(a)(3)(ii), the appropriate information is being maintained under 29 CFR § 5.5 (a)(3)(i), and that such information is correct and complete;

(2) Each laborer and mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations 29 CFR Part 3;

(3) Each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph (3)(ii)(B) of this section.

(D) The falsification of any of the above certifications may subject the Contractor or subcontractor to civil or criminal prosecution under Section 1001 of Title 18 and Section 231 of Title 31 of the United States Code.

(iii) The Contractor or subcontractor shall make the records required under paragraph (3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the sponsor, the Federal Aviation Administration, or the Department of Labor and shall permit such representatives to interview employees during working hours on the job. If the Contractor or subcontractor fails to submit the required records or to make them available, the Federal agency may, after written notice to the Contractor, Sponsor, applicant, or Owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

4. Apprentices and Trainees.

(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Bureau of Apprenticeship and Training, or with a State Apprenticeship Agency recognized by the Bureau, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Bureau of Apprenticeship and Training or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the Contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Bureau of Apprenticeship and Training, or a State Apprenticeship Agency recognized by the Bureau, withdraws approval of an apprenticeship program, the Contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination that provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate that is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the Contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal Employment Opportunity. The utilization of apprentices, trainees, and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR Part 30.

5. Compliance with Copeland Act Requirements.

The Contractor shall comply with the requirements of 29 CFR Part 3, which are incorporated by reference in this contract.

6. Subcontracts.

The Contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR Part 5.5(a)(1) through (10) and such other clauses as the Federal Aviation Administration may by appropriate instructions require, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR Part 5.5.

7. Contract Termination: Debarment.

A breach of the contract clauses in paragraph 1 through 10 of this section may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

8. Compliance with Davis-Bacon and Related Act Requirements.

All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR Parts 1, 3, and 5 are herein incorporated by reference in this contract.

9. Disputes Concerning Labor Standards.

Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR Parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the Contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

10. Certification of Eligibility.

- (i) By entering into this contract, the Contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the Contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).
- (ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).
- (iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 USC 1001.

A11 DEBARMENT AND SUSPENSION

A11.1 SOURCE

2 CFR part 180 (Subpart C)

2 CFR part 1200

DOT Order 4200.5

A11.2 APPLICABILITY

The sponsor must verify that the firm or individual that it is entering into a contract with is not presently suspended, excluded, or debarred by any Federal department or agency from participating in federally assisted projects. The sponsor accomplishes this by:

- 1) Checking the System for Award Management (SAM.gov) to verify that the firm or individual is not listed in SAM.gov as being suspended, debarred, or excluded;
- 2) Collecting a certification from the firm or individual that it is not suspended, debarred, or excluded; and
- 3) Incorporating a clause in the contract that requires lower tier contracts to verify that no suspended, debarred, or excluded firm or individual is included in the project.

Contract Types – This requirement applies to *covered transactions*, which are defined in 2 CFR part 180. AIP funded contracts are non-procurement transactions, as defined by §180.970. Covered transactions include any AIP-funded contract, regardless of tier, that is awarded by a contractor, subcontractor, supplier, consultant, or its agent or representative in any transaction, if the amount of the contract is expected to equal or exceed \$25,000. This includes contracts associated with land acquisition projects.

Use of Provision – No mandatory language provided. The following language is acceptable to the FAA in meeting the intent of this requirement. If the sponsor uses different language, the sponsor's language must fully satisfy the requirements of 2 CFR part 180. For professional service agreements, sponsor may substitute bidder/offeror with consultant.

A11.3 SOLICITATION CLAUSE

A11.3.1 Bidder or Offeror Certification

CERTIFICATION OF OFFERER/BIDDER REGARDING DEBARMENT

By submitting a bid/proposal under this solicitation, the bidder or offeror certifies that neither it nor its principals are presently debarred or suspended by any Federal department or agency from participation in this transaction.

A11.3.2 Lower Tier Contract Certification

CERTIFICATION OF LOWER TIER CONTRACTORS REGARDING DEBARMENT

The successful bidder, by administering each lower tier subcontract that exceeds \$25,000 as a “covered transaction”, must verify each lower tier participant of a “covered transaction” under the project is not presently debarred or otherwise disqualified from participation in this federally assisted project. The successful bidder will accomplish this by:

1. Checking the System for Award Management at website: <http://www.sam.gov>.
2. Collecting a certification statement similar to the Certification of Offerer /Bidder Regarding Debarment, above.
3. Inserting a clause or condition in the covered transaction with the lower tier contract.

If the Federal Aviation Administration later determines that a lower tier participant failed to disclose to a higher tier participant that it was excluded or disqualified at the time it entered the covered transaction, the FAA may pursue any available remedies, including suspension and debarment of the non-compliant participant.

A12 DISADVANTAGED BUSINESS ENTERPRISE

A12.1 SOURCE

49 CFR part 26

A12.2 APPLICABILITY

A sponsor that anticipates awarding \$250,000 or more in AIP funded prime contracts in a federal fiscal year must have an approved Disadvantaged Business Enterprise (DBE) program on file with the FAA Office of Civil Rights (§ 26.21). The approved DBE program will identify a 3-year overall program goal that the sponsor bases on the availability of ready, willing, and able DBEs relative to all businesses ready, willing, and able to participate on the project (§ 26.45).

Contract Types – Sponsors with a DBE program on file with the FAA must include the three following provisions, if applicable:

- 1) Clause in all solicitations for proposals for which a contract goal has been established,
- 2) Clause in each prime contract, and
- 3) Clause in solicitations that are obtaining DBE participation through race/gender neutral means.

Use of Provision –

1. *Solicitations with a DBE Project Goal* – No mandatory language provided. 49 CFR §26.53 requires a sponsor's solicitation to address what a contractor must submit on proposed DBE participation. The language of A12.3.1 is acceptable to the FAA in meeting the intent of this requirement. If the sponsor uses different language, the sponsor's revised language must fully satisfy these requirements. The sponsor may require the contractor's submittal on proposed DBE participation either at bid opening as a matter of responsiveness or within five days of bid opening as a matter of responsibility.
2. *Solicitations Relying on Race-gender Neutral Means* – No mandatory language provided. The language of A12.3.2 is acceptable to the FAA in meeting the intent of this requirement. If the sponsor uses different language, the sponsor's revised language must fully satisfy requirements for a sponsor that is not applying a project specific contract goal but is covered by a DBE program on file with the FAA.
3. *Contracts Covered by DBE Program* – **MANDATORY TEXT PROVIDED.** Sponsors must incorporate this language if they have a DBE program on file with the FAA. This includes projects where DBE participation is obtained through race-gender neutral means (i.e. no project goal). Sections §26.13 and §26.29 establish mandatory language for contractor assurance and prompt payment. The sponsor must not modify the language.
4. Sponsors that are not required to have a DBE program on file with the FAA are not required to include DBE provisions and clauses.

A12.3 REQUIRED PROVISIONS

A12.3.1 Solicitation Language (Solicitations that include a Project Goal)

Information Submitted as a matter of bidder responsiveness:

The Owner's award of this contract is conditioned upon Bidder or Offeror satisfying the good faith effort requirements of 49 CFR §26.53.

As a condition of bid responsiveness, the Bidder or Offeror must submit the following information with its proposal on the forms provided herein:

- 1) The names and addresses of Disadvantaged Business Enterprise (DBE) firms that will participate in the contract;
- 2) A description of the work that each DBE firm will perform;
- 3) The dollar amount of the participation of each DBE firm listed under (1)
- 4) Written statement from Bidder or Offeror that attests their commitment to use the DBE firm(s) listed under (1) to meet the Owner's project goal; and
- 5) If Bidder or Offeror cannot meet the advertised project DBE goal, evidence of good faith efforts undertaken by the Bidder or Offeror as described in appendix A to 49 CFR part 26.

Information submitted as a matter of bidder responsibility:

The Owner's award of this contract is conditioned upon Bidder or Offeror satisfying the good faith effort requirements of 49 CFR §26.53.

The successful Bidder or Offeror must provide written confirmation of participation from each of the DBE firms the Bidder or Offeror lists in its commitment within five days after bid opening.

- 1) The names and addresses of Disadvantaged Business Enterprise (DBE) firms that will participate in the contract;
- 2) A description of the work that each DBE firm will perform;
- 3) The dollar amount of the participation of each DBE firm listed under (1)
- 4) Written statement from Bidder or Offeror that attests their commitment to use the DBE firm(s) listed under (1) to meet the Owner's project goal; and
- 5) If Bidder or Offeror cannot meet the advertised project DBE goal, evidence of good faith efforts undertaken by the Bidder or Offeror as described in appendix A to 49 CFR part 26.

A12.3.2 Solicitation Language (Race/Gender Neutral Means)

The requirements of 49 CFR part 26 apply to this contract. It is the policy of the SAVANNAH AIRPORT COMMISSION to practice nondiscrimination based on race, color, sex, or national origin in the award or performance of this contract. The Owner encourages participation by all firms qualifying under this solicitation regardless of business size or ownership.

A12.3.3 Prime Contracts (Projects Covered by a DBE Program)

DISADVANTAGED BUSINESS ENTERPRISES

Contract Assurance (§ 26.13) –

The Contractor or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The Contractor shall carry out applicable requirements of 49 CFR part 26 in the award and administration of Department of Transportation-assisted contracts. Failure by the Contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the Owner deems appropriate, which may include, but is not limited to:

- 1) Withholding monthly progress payments;
- 2) Assessing sanctions;
- 3) Liquidated damages; and/or
- 4) Disqualifying the Contractor from future bidding as non-responsible.

Prompt Payment (§26.29) – The prime contractor agrees to pay each subcontractor under this prime contract for satisfactory performance of its contract no later than [specify number] days from the receipt of each payment the prime contractor receives from SAVANNAH AIRPORT COMMISSION. The prime contractor agrees further to return retainage payments to each subcontractor within [specify the same number as above] 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 SAVANNAH AIRPORT COMMISSION. This clause applies to both DBE and non-DBE subcontractors.

A13 DISTRACTED DRIVING

A13.1 SOURCE

Executive Order 13513

DOT Order 3902.10

A13.2 APPLICABILITY

The FAA encourages recipients of Federal grant funds to adopt and enforce safety policies that decrease crashes by distracted drivers, including policies to ban text messaging while driving when performing work related to a grant or subgrant.

Contract Types – Sponsors must insert this provision in all AIP funded contracts that exceed the micro-purchase threshold of 2 CFR §200.67 (currently set at \$3,500).

Use of Provision – No mandatory text provided. The following language is acceptable to the FAA in meeting the intent of this requirement. If the sponsor uses different language, the sponsor’s revised language must fully satisfy these requirements.

A13.3 CONTRACT CLAUSE

TEXTING WHEN DRIVING

In accordance with Executive Order 13513, “Federal Leadership on Reducing Text Messaging While Driving”, (10/1/2009) and DOT Order 3902.10, “Text Messaging While Driving”, (12/30/2009), the Federal Aviation Administration encourages recipients of Federal grant funds to adopt and enforce safety policies that decrease crashes by distracted drivers, including policies to ban text messaging while driving when performing work related to a grant or subgrant.

In support of this initiative, the Owner encourages the Contractor to promote policies and initiatives for its employees and other work personnel that decrease crashes by distracted drivers, including policies that ban text messaging while driving motor vehicles while performing work activities associated with the project. The Contractor must include the substance of this clause in all sub-tier contracts exceeding \$3,500 that involve driving a motor vehicle in performance of work activities associated with the project.

A14 ENERGY CONSERVATION REQUIREMENTS

A14.1 SOURCE

2 CFR § 200, Appendix II(H)

A14.2 APPLICABILITY

The Energy Conservation Requirements of 2 CFR § 200 Appendix II(H) requires this provision on energy efficiency.

Contract Types – The sponsor must include this provision in all AIP funded contracts and lower-tier contracts.

Use of Provision – No mandatory text provided. The following language is acceptable to the FAA and meets the intent of this requirement. If the sponsor uses different language, the sponsor’s revised language must fully satisfy these requirements. Sponsor may substitute “Contractor and subcontractor” with “Consultant and sub-consultant” for professional service agreements.

A14.3 CONTRACT CLAUSE

ENERGY CONSERVATION REQUIREMENTS

Contractor and Subcontractor agree to comply with mandatory standards and policies relating to energy efficiency as contained in the state energy conservation plan issued in compliance with the Energy Policy and Conservation Act (42 USC 6201*et seq*).

A15 DRUG FREE WORKPLACE REQUIREMENTS

A15.1 SOURCE

49 CFR part 32

Drug-Free Workplace Act of 1988 (41 U.S.C. 701 *et seq.*, as amended)

A15.2 APPLICABILITY

The Drug-Free Workplace Act of 1988 requires some Federal contractors and *all* Federal grantees to agree that they will provide drug-free workplaces as a condition of receiving a contract or grant from a Federal agency. The Act does ***not*** apply to contractors, subcontractors, or subgrantees, although the Federal grantees workplace may be where the contractors, subcontractors, or subgrantees are working.

Contract Types – This provision applies to all AIP funded projects, but not to the contracts between the grantee (the sponsor) and a contractor, subcontractors, suppliers, or subgrantees.

Use of Provision – No mandatory or recommended text provided because the requirements do not extend beyond the sponsor level.

A15.3 CONTRACT CLAUSE

None.

A16 EQUAL EMPLOYMENT OPPORTUNITY (EEO)

A16.1 SOURCE

2 CFR 200, Appendix II(C)

41 CFR § 60-1.4

41 CFR § 60-4.3

Executive Order 11246

A16.2 APPLICABILITY

The purpose of this provision is to provide equal opportunity for all persons, without regard to race, color, religion, sex, or national origin who are employed or seeking employment with contractors performing under a federally assisted construction contract. There are two provisions — a construction clause and a specification clause.

The equal opportunity contract clause must be included in any contract or subcontract when the amount exceeds \$10,000. Once the equal opportunity clause is determined to be applicable, the contract or subcontract must include the clause for the remainder of the year, regardless of the amount or the contract.

Contract Types –

Construction – The sponsor must incorporate contract and specification language in all construction contracts and subcontracts as required above.

Equipment – The sponsor must incorporate contract and specification language into all equipment contracts as required above that involves installation of equipment onsite (e.g. electrical vault equipment). This provision does not apply to equipment acquisition projects where the manufacture of the equipment takes place offsite at the vendor plant (e.g. ARFF and SRE vehicles).

Professional Services – The sponsor must include contract and specification language into all professional service agreements as required above.

Property – The sponsor must include contract and specification language into all land acquisition projects that include work that qualifies as construction work as defined by 41 CFR part 60 as required above. An example is installation of boundary fencing.

Use of Provision – MANDATORY TEXT. 41 CFR § 60-1.4 provides the mandatory *contract* language. 41 CFR § 60-4.3 provides the mandatory *specification* language. The sponsor must incorporate these clauses without modification.

A16.3 MANDATORY CONTRACT CLAUSE

A16.3.1 EEO Contract Clause

EQUAL OPPORTUNITY CLAUSE

During the performance of this contract, the Contractor agrees as follows:

(1) The Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, sexual orientation, gender identify, or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff, or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.

(2) The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive considerations for employment without regard to race, color, religion, sex, or national origin.

(3) The Contractor will send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the said labor union or workers' representatives of the Contractor's commitments under this section and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(4) The Contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.

(5) The Contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the administering agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(6) In the event of the Contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this contract may be canceled, terminated, or suspended in whole or in part and the Contractor may be declared ineligible for further Government contracts or federally assisted construction contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

(7) The Contractor will include the portion of the sentence immediately preceding paragraph (1) and the provisions of paragraphs (1) through (7) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The Contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance: *Provided, however*, that in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the administering agency the Contractor may request the United States to enter into such litigation to protect the interests of the United States.

A16.3.2 EEO Specification

STANDARD FEDERAL EQUAL EMPLOYMENT OPPORTUNITY CONSTRUCTION CONTRACT SPECIFICATIONS

1. As used in these specifications:

- a. “Covered area” means the geographical area described in the solicitation from which this contract resulted;
- b. “Director” means Director, Office of Federal Contract Compliance Programs (OFCCP), U.S. Department of Labor, or any person to whom the Director delegates authority;
- c. “Employer identification number” means the Federal social security number used on the Employer’s Quarterly Federal Tax Return, U.S. Treasury Department Form 941;
- d. “Minority” includes:
 - (1) Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);
 - (2) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin regardless of race);
 - (3) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); and
 - (4) American Indian or Alaskan native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).

2. Whenever the Contractor, or any subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of \$10,000 the provisions of these specifications and the Notice which contains the applicable goals for minority and female participation and which is set forth in the solicitations from which this contract resulted.

3. If the Contractor is participating (pursuant to 41 CFR part 60-4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area (including goals and timetables) shall be in accordance with that Plan for those trades which have unions participating in the Plan. Contractors shall be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each contractor or subcontractor participating in an approved plan is individually required to comply with its obligations under the EEO clause and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other contractors or subcontractors toward a goal in an approved Plan does not excuse any covered contractor’s or subcontractor’s failure to take good faith efforts to achieve the Plan goals and timetables.

4. The Contractor shall implement the specific affirmative action standards provided in paragraphs 7a through 7p of these specifications. The goals set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the Contractor should reasonably be able to achieve in each construction trade in

which it has employees in the covered area. Covered construction contractors performing construction work in a geographical area where they do not have a Federal or federally assisted construction contract shall apply the minority and female goals established for the geographical area where the work is being performed. Goals are published periodically in the Federal Register in notice form, and such notices may be obtained from any Office of Federal Contract Compliance Programs office or from Federal procurement contracting officers. The Contractor is expected to make substantially uniform progress in meeting its goals in each craft during the period specified.

5. Neither the provisions of any collective bargaining agreement nor the failure by a union with whom the Contractor has a collective bargaining agreement to refer either minorities or women shall excuse the Contractor's obligations under these specifications, Executive Order 11246, or the regulations promulgated pursuant thereto.

6. In order for the non-working training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees shall be employed by the Contractor during the training period and the Contractor shall have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees shall be trained pursuant to training programs approved by the U.S. Department of Labor.

7. The Contractor shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of the Contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully and shall implement affirmative action steps at least as extensive as the following:

- a. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the Contractor's employees are assigned to work. The Contractor, where possible, will assign two or more women to each construction project. The Contractor shall specifically ensure that all foremen, superintendents, and other onsite supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities.
- b. Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.
- c. Maintain a current file of the names, addresses, and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source, or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this shall be documented in the file with the reason therefore along with whatever additional actions the Contractor may have taken.
- d. Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person or female sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.

- e. Develop on-the-job training opportunities and/or participate in training programs for the area which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under 7b above.
- f. Disseminate the Contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting its EEO obligations; by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.
- g. Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination, or other employment decisions, including specific review of these items, with onsite supervisory personnel such as superintendents, general foremen, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.
- h. Disseminate the Contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the Contractor's EEO policy with other contractors and subcontractors with whom the Contractor does or anticipates doing business.
- i. Direct its recruitment efforts, both oral and written, to minority, female, and community organizations, to schools with minority and female students; and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the Contractor shall send written notification to organizations, such as the above, describing the openings, screening procedures, and tests to be used in the selection process.
- j. Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer, and vacation employment to minority and female youth both on the site and in other areas of a contractor's workforce.
- k. Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR part 60-3.
- l. Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel, for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.
- m. Ensure that seniority practices, job classifications, work assignments, and other personnel practices do not have a discriminatory effect by continually monitoring all personnel and

employment related activities to ensure that the EEO policy and the Contractor's obligations under these specifications are being carried out.

n. Ensure that all facilities and company activities are non-segregated except that separate or single user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.

o. Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.

p. Conduct a review, at least annually, of all supervisor's adherence to and performance under the Contractor's EEO policies and affirmative action obligations.

8. Contractors are encouraged to participate in voluntary associations, which assist in fulfilling one or more of their affirmative action obligations (7a through 7p). The efforts of a contractor association, joint contractor union, contractor community, or other similar groups of which the Contractor is a member and participant may be asserted as fulfilling any one or more of its obligations under 7a through 7p of these specifications provided that the Contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female workforce participation, makes a good faith effort to meet its individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply, however, is the Contractor's and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.

9. A single goal for minorities and a separate single goal for women have been established. The Contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, if the particular group is employed in a substantially disparate manner (for example, even though the Contractor has achieved its goals for women generally), the Contractor may be in violation of the Executive Order if a specific minority group of women is underutilized.

10. The Contractor shall not use the goals and timetables or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.

11. The Contractor shall not enter into any subcontract with any person or firm debarred from Government contracts pursuant to Executive Order 11246.

12. The Contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination, and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Office of Federal Contract Compliance Programs. Any contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.

13. The Contractor, in fulfilling its obligations under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in paragraph 7 of these specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of the Executive Order, the

implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR part 60-4.8.

14. The Contractor shall designate a responsible official to monitor all employment related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the Government, and to keep records. Records shall at least include for each employee, the name, address, telephone number, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status (e.g., mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.

15. Nothing herein provided shall be construed as a limitation upon the application of other laws which establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g. those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

A17 FEDERAL FAIR LABOR STANDARDS ACT (FEDERAL MINIMUM WAGE)

A17.1 SOURCE

29 USC § 201, et seq

A17.2 APPLICABILITY

The U.S. Department of Labor (DOL) Wage and Hour Division administers the Fair Labor Standards Act (FLSA). This act prescribes federal standards for basic minimum wage, overtime pay, record keeping, and child labor standards.

Contract Types – Per the Department of Labor, all employees of certain enterprises having workers engaged in interstate commerce; producing goods for interstate commerce; or handling, selling, or otherwise working on goods or materials that have been moved in or produced for such commerce by any person are covered by the FLSA.

All consultants, sub-consultants, contractors, and subcontractors employed under this federally assisted project must comply with the FLSA.

Professional Services – 29 CFR § 213 exempts employees in a bona fide executive, administrative or professional capacity. Because professional firms employ individuals that are not covered by this exemption, the sponsor's agreement with a professional services firm must include the FLSA provision.

Use of Provision – No mandatory text provided. The following language is acceptable to the FAA and meets the intent of this requirement. If the sponsor uses different language, the sponsor's language must fully satisfy the requirements of 29 USC § 201. The sponsor must select *contractor* or *consultant*, as appropriate for the contract.

A17.3 SOLICITATION CLAUSE

All contracts and subcontracts that result from this solicitation incorporate by reference the provisions of 29 CFR part 201, the Federal Fair Labor Standards Act (FLSA), with the same force and effect as if given in full text. The FLSA sets minimum wage, overtime pay, recordkeeping, and child labor standards for full and part-time workers.

The [*Contractor* | *Consultant*] has full responsibility to monitor compliance to the referenced statute or regulation. The [*Contractor* | *Consultant*] must address any claims or disputes that arise from this requirement directly with the U.S. Department of Labor – Wage and Hour Division.

A18 LOBBYING AND INFLUENCING FEDERAL EMPLOYEES

A18.1 SOURCE

31 USC § 1352 – Byrd Anti-Lobbying Amendment

2 CFR part 200, Appendix II(J)

49 CFR part 20, Appendix A

A18.2 APPLICABILITY

Consultants and contractors that apply or bid for an award of \$100,000 or more must certify that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any Federal contract, grant, or another award covered by 31 USC 1352. Each tier must also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award.

Contract Types – The sponsor must incorporate this provision into all contracts exceeding \$100,000.

Use of Provision – MANDATORY TEXT. Appendix A to 49 CFR Part 20 prescribes language the sponsor must use. The sponsor must incorporate this provision without modification.

A18.3 CONTRACT CLAUSE

CERTIFICATION REGARDING LOBBYING

The Bidder or Offeror certifies by signing and submitting this bid or proposal, to the best of his or her knowledge and belief, that:

- (1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the Bidder or Offeror, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
- (2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, “Disclosure Form to Report Lobbying,” in accordance with its instructions.
- (3) The undersigned shall require that the language of this certification be included in the award documents for all sub-awards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all sub-recipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

A19 PROHIBITION of SEGREGATED FACILITIES

A19.1 SOURCE

41 CFR § 60

A19.2 APPLICABILITY

The contractor must comply with the requirements of the EEO clause by ensuring that facilities they provide for employees are free of segregation on the basis of race, color, religion, sex, sexual orientation, gender identity, or national origin. This clause must be included in all contracts that include the equal opportunity clause, regardless of the amount of the contract.

Contract Types – AIP sponsors must incorporate the Prohibition of Segregated Facilities clause in any contract containing the Equal Employment Opportunity clause of 41 CFR §60.1. This obligation flows down to subcontract and sub-tier purchase orders containing the Equal Employment Opportunity clause.

Construction – Construction work means construction, rehabilitation, alteration, conversion, extension, demolition or repair of buildings, highways, or other changes or improvements to real property, including facilities providing utility services. The term also includes the supervision, inspection, and other onsite functions incidental to the actual construction.

Equipment – On site installation of equipment such as airfield lighting control equipment meets the definition of construction and thus this provision would apply. This provision does not apply to equipment projects involving manufacture of the item at a vendor's manufacturing plant. An example would be the manufacture of a SRE or ARFF vehicle.

Professional Services – Professional services that include tasks that qualify as construction work as defined by 41 CFR part 60. Examples include the installation of noise monitoring equipment.

Property/Land – Land acquisition contracts that include tasks that qualify as construction work as defined by 41 CFR part 60. Examples include demolition of structures or installation of boundary fencing.

Use of Provision – No mandatory text provided. The following language is acceptable to the FAA and meets the intent of this requirement. If the sponsor uses different language, the sponsor's language must fully satisfy the requirements of 41 CFR § 60.

A19.3 CONTRACT CLAUSE

PROHIBITION OF SEGREGATED FACILITIES

(a) The Contractor agrees that it does not and will not maintain or provide for its employees any segregated facilities at any of its establishments, and that it does not and will not permit its employees to perform their services at any location under its control where segregated facilities are maintained. The Contractor agrees that a breach of this clause is a violation of the Equal Employment Opportunity clause in this contract.

(b) "Segregated facilities," as used in this clause, means any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees that are segregated by explicit directive or are in fact segregated on the

basis of race, color, religion, sex, or national origin because of written or oral policies or employee custom. The term does not include separate or single-user rest rooms or necessary dressing or sleeping areas provided to assure privacy between the sexes.

(c) The Contractor shall include this clause in every subcontract and purchase order that is subject to the Equal Employment Opportunity clause of this contract.

A20 OCCUPATIONAL SAFETY AND HEALTH ACT OF 1970

A20.1 SOURCE

29 CFR part 1910

A20.2 APPLICABILITY

Contract Types – All contracts and subcontracts must comply with the Occupational Safety and Health Act of 1970 (OSH). The U.S. Department of Labor Occupational Safety and Health Administration (OSHA) oversees the workplace health and safety standards wage provisions from OSH.

Use of Provision – No mandatory text provided. The following language is acceptable to the FAA and meets the intent of this requirement. If the sponsor uses different language, the sponsor's language must fully satisfy the requirements of 20 CFR part 1910.

A20.3 CONTRACT CLAUSE

All contracts and subcontracts that result from this solicitation incorporate by reference the requirements of 29 CFR Part 1910 with the same force and effect as if given in full text. The employer must provide a work environment that is free from recognized hazards that may cause death or serious physical harm to the employee. The employer retains full responsibility to monitor its compliance and their subcontractor's compliance with the applicable requirements of the Occupational Safety and Health Act of 1970 (20 CFR Part 1910). The employer must address any claims or disputes that pertain to a referenced requirement directly with the U.S. Department of Labor – Occupational Safety and Health Administration.

A21 PROCUREMENT OF RECOVERED MATERIALS

A21.1 SOURCE

2 CFR § 200.322

40 CFR part 247

Solid Waste Disposal Act

A21.2 APPLICABILITY

Sponsors of AIP funded development and equipment projects must comply with Section 6002 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act. Section 6002 emphasizes maximizing energy and resource recovery through use of affirmative procurement actions for recovered materials identified in the Environmental Protection Agency (EPA) guidelines codified at 40 CFR part 247. When acquiring items designated in the guidelines, the sponsor must procure items that contain the highest percentage of recovered materials practicable, consistent with maintaining a satisfactory level of competition.

Contract Types – This provision applies to any contracts that include procurement of products designated in subpart B of 40 CFR part 247 where the purchase price of the item exceeds \$10,000 or the value of the quantity acquired by the preceding fiscal year exceeded \$10,000.

Construction and Equipment – Include this provision in all construction and equipment projects.

Professional Services and Property – Include this provision if the agreement includes procurement of a product that exceeds \$10,000.

Use of Provision – No mandatory text provided. The following language is acceptable to the FAA and meets the intent of this requirement. If the sponsor uses different language, the sponsor's language must fully satisfy the requirements of 2 CFR § 200.

A21.3 CONTRACT CLAUSE

PROCUREMENT OF RECOVERED MATERIALS

Contractor and subcontractor agree to comply with Section 6002 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act, and the regulatory provisions of 40 CFR Part 247. In the performance of this contract and to the extent practicable, the Contractor and subcontractors are to use products containing the highest percentage of recovered materials for items designated by the Environmental Protection Agency (EPA) under 40 CFR Part 247 whenever:

- 1) The contract requires procurement of \$10,000 or more of a designated item during the fiscal year;
or
- 2) The contractor has procured \$10,000 or more of a designated item using Federal funding during the previous fiscal year.

The list of EPA-designated items is available at www.epa.gov/smm/comprehensive-procurement-guidelines-construction-products.

Section 6002(c) establishes exceptions to the preference for recovery of EPA-designated products if the contractor can demonstrate the item is:

- a) Not reasonably available within a timeframe providing for compliance with the contract performance schedule;
- b) Fails to meet reasonable contract performance requirements; or
- c) Is only available at an unreasonable price.

A22 RIGHT TO INVENTIONS

A22.1 SOURCE

2 CFR § 200, Appendix II(F)

37 CFR §401

A22.2 APPLICABILITY

Contract Types – This provision applies to all contracts and subcontracts with small business firms or nonprofit organizations that include performance of *experimental, developmental, or research work*. This clause is not applicable to construction, equipment, or professional service contracts unless the contract includes *experimental, developmental, or research work*.

Use of Provision – No mandatory text provided. The following language is acceptable to the FAA and meets the intent of this requirement. If the sponsor uses different language, the sponsor's language must fully satisfy the requirements of Appendix II to 2 CFR part 200.

A22.3 CONTRACT CLAUSE

RIGHTS TO INVENTIONS

Contracts or agreements that include the performance of experimental, developmental, or research work must provide for the rights of the Federal Government and the Owner in any resulting invention as established by 37 CFR part 401, Rights to Inventions Made by Non-profit Organizations and Small Business Firms under Government Grants, Contracts, and Cooperative Agreements. This contract incorporates by reference the patent and inventions rights as specified within 37 CFR §401.14. Contractor must include this requirement in all sub-tier contracts involving experimental, developmental, or research work.

A23 SEISMIC SAFETY

A23.1 SOURCE

49 CFR part 41

A23.2 APPLICABILITY

Contract Types – This provision applies to construction of new buildings and additions to existing buildings financed in whole or in part through the Airport Improvement Program.

Professional Services– Sponsor must incorporate this clause in any contract involved in the construction of new buildings or structural addition to existing buildings.

Construction – Sponsor must incorporate this clause in any contract involved in the construction of new buildings or structural addition to existing buildings.

Equipment – Sponsor must include the construction provision if the project involves construction or structural addition to a building such as an electrical vault project to accommodate or install equipment.

Land – This provision will not typically apply to a property/land project.

Use of Provision – No mandatory text provided. The following language is acceptable to the FAA and meets the intent of this requirement. If the sponsor uses different language, the sponsor’s language must fully satisfy the requirements of 49 CFR part 41.

A23.3 CONTRACT CLAUSE

A23.3.1 Professional Service Agreements for Design

SEISMIC SAFETY

In the performance of design services, the Consultant agrees to furnish a building design and associated construction specification that conform to a building code standard that provides a level of seismic safety substantially equivalent to standards as established by the National Earthquake Hazards Reduction Program (NEHRP). Local building codes that model their building code after the current version of the International Building Code (IBC) meet the NEHRP equivalency level for seismic safety. At the conclusion of the design services, the Consultant agrees to furnish the Owner a “certification of compliance” that attests conformance of the building design and the construction specifications with the seismic standards of NEHRP or an equivalent building code.

A23.3.2 Construction Contracts

SEISMIC SAFETY

The Contractor agrees to ensure that all work performed under this contract, including work performed by subcontractors, conforms to a building code standard that provides a level of seismic safety substantially equivalent to standards established by the National Earthquake Hazards Reduction Program (NEHRP). Local building codes that model their code after the current version of the International Building Code (IBC) meet the NEHRP equivalency level for seismic safety.

A24 TAX DELINQUENCY AND FELONY CONVICTIONS

A24.1 SOURCE

Sections 415 and 416 of Title IV, Division L of the Consolidated Appropriations Act, 2014 (Pub. L. 113-76), and similar provisions in subsequent appropriations acts.

DOT Order 4200.6 - Requirements for Procurement and Non-Procurement Regarding Tax Delinquency and Felony Convictions

A24.2 APPLICABILITY

The sponsor must ensure that no funding goes to any contractor who:

- Has been convicted of a Federal felony within the last 24 months; or
- Has any outstanding tax liability for which all judicial and administrative remedies have lapsed or been exhausted.

Contract Types – This provision applies to all contracts funded in whole or part with AIP.

Use of Provision – The following language is acceptable to the FAA and meets the intent of this requirement. If the sponsor uses different language, the sponsor's language must fully satisfy the requirements of DOT Order 4200.6.

A24.3 CONTRACT CLAUSE

CERTIFICATION OF OFFERER/BIDDER REGARDING TAX DELINQUENCY AND FELONY CONVICTIONS

The applicant must complete the following two certification statements. The applicant must indicate its current status as it relates to tax delinquency and felony conviction by inserting a checkmark (✓) in the space following the applicable response. The applicant agrees that, if awarded a contract resulting from this solicitation, it will incorporate this provision for certification in all lower tier subcontracts.

Certifications

- 1) The applicant represents that it is (✓) is not (✓) a corporation that has any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability.
- 2) The applicant represents that it is (✓) is not (✓) is not a corporation that was convicted of a criminal violation under any Federal law within the preceding 24 months.

Note

If an applicant responds in the affirmative to either of the above representations, the applicant is ineligible to receive an award unless the sponsor has received notification from the agency suspension and debarment official (SDO) that the SDO has considered suspension or debarment and determined that further action is not required to protect the Government's interests. The applicant therefore must provide information to the owner about its tax liability or conviction to the Owner, who will then notify

the FAA Airports District Office, which will then notify the agency's SDO to facilitate completion of the required considerations before award decisions are made.

Term Definitions

Felony conviction: Felony conviction means a conviction within the preceding twenty-four (24) months of a felony criminal violation under any Federal law and includes conviction of an offense defined in a section of the U.S. code that specifically classifies the offense as a felony and conviction of an offense that is classified as a felony under 18 U.S.C. § 3559.

Tax Delinquency: A tax delinquency is any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted, or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability.

A25 TERMINATION OF CONTRACT

A25.1 SOURCE

2 CFR § 200 Appendix II(B)

FAA Advisory Circular 150/5370-10, Section 80-09

A25.2 APPLICABILITY

Contract Types – All contracts and subcontracts in excess of \$10,000 must address *termination for cause* and *termination for convenience* by the sponsor. The provision must address the manner (i.e. notice, opportunity to cure, and effective date) by which the sponsor's contract will be affected and the basis for settlement (i.e. incurred expenses, completed work, profit, etc.).

Use of Provision –

Termination for Default – **MANDATORY TEXT.** Section 80-09 of FAA Advisory Circular 150/5370-10 establishes standard language for Termination for Default under a construction contract. The sponsor must not make any changes to this standard language.

Termination for Convenience – No mandatory text provided. The sponsor must include a clause for termination for convenience. The following language is acceptable to the FAA and meets the intent of this requirement. If the sponsor uses different language, the sponsor's language must fully satisfy the requirements of Appendix II to 2 CFR part 200.

Equipment, Professional Services, and Property – No mandatory text provided. The sponsor may use their established clause language provided that it adequately addresses the intent of Appendix II(B) to Part 200, which addresses termination for fault and for convenience.

A25.3 CONTRACT CLAUSE

A25.3.1 Termination for Convenience

TERMINATION FOR CONVENIENCE (CONSTRUCTION & EQUIPMENT CONTRACTS)

The Owner may terminate this contract in whole or in part at any time by providing written notice to the Contractor. Such action may be without cause and without prejudice to any other right or remedy of Owner. Upon receipt of a written notice of termination, except as explicitly directed by the Owner, the Contractor shall immediately proceed with the following obligations regardless of any delay in determining or adjusting amounts due under this clause:

1. Contractor must immediately discontinue work as specified in the written notice.
2. Terminate all subcontracts to the extent they relate to the work terminated under the notice.
3. Discontinue orders for materials and services except as directed by the written notice.
4. Deliver to the Owner all fabricated and partially fabricated parts, completed and partially completed work, supplies, equipment and materials acquired prior to termination of the work, and as directed in the written notice.
5. Complete performance of the work not terminated by the notice.

6. Take action as directed by the Owner to protect and preserve property and work related to this contract that Owner will take possession.

Owner agrees to pay Contractor for:

- 1) completed and acceptable work executed in accordance with the contract documents prior to the effective date of termination;
- 2) documented expenses sustained prior to the effective date of termination in performing work and furnishing labor, materials, or equipment as required by the contract documents in connection with uncompleted work;
- 3) reasonable and substantiated claims, costs, and damages incurred in settlement of terminated contracts with Subcontractors and Suppliers; and
- 4) reasonable and substantiated expenses to the Contractor directly attributable to Owner's termination action.

Owner will not pay Contractor for loss of anticipated profits or revenue or other economic loss arising out of or resulting from the Owner's termination action.

The rights and remedies this clause provides are in addition to any other rights and remedies provided by law or under this contract.

TERMINATION FOR CONVENIENCE (PROFESSIONAL SERVICES)

The Owner may, by written notice to the Consultant, terminate this Agreement for its convenience and without cause or default on the part of Consultant. Upon receipt of the notice of termination, except as explicitly directed by the Owner, the Contractor must immediately discontinue all services affected.

Upon termination of the Agreement, the Consultant must deliver to the Owner all data, surveys, models, drawings, specifications, reports, maps, photographs, estimates, summaries, and other documents and materials prepared by the Engineer under this contract, whether complete or partially complete.

Owner agrees to make just and equitable compensation to the Consultant for satisfactory work completed up through the date the Consultant receives the termination notice. Compensation will not include anticipated profit on non-performed services.

Owner further agrees to hold Consultant harmless for errors or omissions in documents that are incomplete as a result of the termination action under this clause.

A25.3.2 Termination for Default

TERMINATION FOR DEFAULT (CONSTRUCTION)

Section 80-09 of FAA Advisory Circular 150/5370-10 establishes conditions, rights, and remedies associated with Owner termination of this contract due to default of the Contractor.

TERMINATION FOR DEFAULT (EQUIPMENT)

The Owner may, by written notice of default to the Contractor, terminate all or part of this Contract if the Contractor:

1. Fails to commence the Work under the Contract within the time specified in the Notice- to-Proceed;

2. Fails to make adequate progress as to endanger performance of this Contract in accordance with its terms;
3. Fails to make delivery of the equipment within the time specified in the Contract, including any Owner approved extensions;
4. Fails to comply with material provisions of the Contract;
5. Submits certifications made under the Contract and as part of their proposal that include false or fraudulent statements; or
6. Becomes insolvent or declares bankruptcy.

If one or more of the stated events occur, the Owner will give notice in writing to the Contractor and Surety of its intent to terminate the contract for cause. At the Owner's discretion, the notice may allow the Contractor and Surety an opportunity to cure the breach or default.

If within [10] days of the receipt of notice, the Contractor or Surety fails to remedy the breach or default to the satisfaction of the Owner, the Owner has authority to acquire equipment by other procurement action. The Contractor will be liable to the Owner for any excess costs the Owner incurs for acquiring such similar equipment.

Payment for completed equipment delivered to and accepted by the Owner shall be at the Contract price. The Owner may withhold from amounts otherwise due the Contractor for such completed equipment, such sum as the Owner determines to be necessary to protect the Owner against loss because of Contractor default.

Owner will not terminate the Contractor's right to proceed with the Work under this clause if the delay in completing the work arises from unforeseeable causes beyond the control and without the fault or negligence of the Contractor. Examples of such acceptable causes include: acts of God, acts of the Owner, acts of another Contractor in the performance of a contract with the Owner, and severe weather events that substantially exceed normal conditions for the location.

If, after termination of the Contractor's right to proceed, the Owner determines that the Contractor was not in default, or that the delay was excusable, the rights and obligations of the parties will be the same as if the Owner issued the termination for the convenience the Owner.

The rights and remedies of the Owner in this clause are in addition to any other rights and remedies provided by law or under this contract.

TERMINATION FOR DEFAULT (PROFESSIONAL SERVICES)

Either party may terminate this Agreement for cause if the other party fails to fulfill its obligations that are essential to the completion of the work per the terms and conditions of the Agreement. The party initiating the termination action must allow the breaching party an opportunity to dispute or cure the breach.

The terminating party must provide the breaching party [7] days advance written notice of its intent to terminate the Agreement. The notice must specify the nature and extent of the breach, the conditions necessary to cure the breach, and the effective date of the termination action. The rights and remedies in this clause are in addition to any other rights and remedies provided by law or under this agreement.

- a) **Termination by Owner:** The Owner may terminate this Agreement in whole or in part, for the failure of the Consultant to:
1. Perform the services within the time specified in this contract or by Owner approved extension;
 2. Make adequate progress so as to endanger satisfactory performance of the Project; or
 3. Fulfill the obligations of the Agreement that are essential to the completion of the Project.

Upon receipt of the notice of termination, the Consultant must immediately discontinue all services affected unless the notice directs otherwise. Upon termination of the Agreement, the Consultant must deliver to the Owner all data, surveys, models, drawings, specifications, reports, maps, photographs, estimates, summaries, and other documents and materials prepared by the Engineer under this contract, whether complete or partially complete.

Owner agrees to make just and equitable compensation to the Consultant for satisfactory work completed up through the date the Consultant receives the termination notice. Compensation will not include anticipated profit on non-performed services.

Owner further agrees to hold Consultant harmless for errors or omissions in documents that are incomplete as a result of the termination action under this clause.

If, after finalization of the termination action, the Owner determines the Consultant was not in default of the Agreement, the rights and obligations of the parties shall be the same as if the Owner issued the termination for the convenience of the Owner.

- b) **Termination by Consultant:** The Consultant may terminate this Agreement in whole or in part, if the Owner:
1. Defaults on its obligations under this Agreement;
 2. Fails to make payment to the Consultant in accordance with the terms of this Agreement;
 3. Suspends the Project for more than [180] days due to reasons beyond the control of the Consultant.

Upon receipt of a notice of termination from the Consultant, Owner agrees to cooperate with Consultant for the purpose of terminating the agreement or portion thereof, by mutual consent. If Owner and Consultant cannot reach mutual agreement on the termination settlement, the Consultant may, without prejudice to any rights and remedies it may have, proceed with terminating all or parts of this Agreement based upon the Owner's breach of the contract.

In the event of termination due to Owner breach, the Engineer is entitled to invoice Owner and to receive full payment for all services performed or furnished in accordance with this Agreement and all justified reimbursable expenses incurred by the Consultant through the effective date of termination action. Owner agrees to hold Consultant harmless for errors or omissions in documents that are incomplete as a result of the termination action under this clause.

A26 TRADE RESTRICTION CERTIFICATION

A26.1 SOURCE

49 USC § 50104

49 CFR part 30

A26.2 APPLICABILITY

Unless waived by the Secretary of Transportation, sponsors may not use AIP funds on a product or service from a foreign country included in the current list of countries that discriminate against U.S. firms as published by the Office of the United States Trade Representative (USTR).

Contract Types – The trade restriction certification and clause applies to all AIP funded projects.

Use of Provision – MANDATORY TEXT. 49 CFR part 30 prescribes the language for this model clause. The sponsor must include this certification language in all contracts and subcontracts without modification.

A26.3 SOLICITATION CLAUSE

TRADE RESTRICTION CERTIFICATION

By submission of an offer, the Offeror certifies that with respect to this solicitation and any resultant contract, the Offeror –

- 1) is not owned or controlled by one or more citizens of a foreign country included in the list of countries that discriminate against U.S. firms as published by the Office of the United States Trade Representative (USTR);
- 2) has not knowingly entered into any contract or subcontract for this project with a person that is a citizen or national of a foreign country included on the list of countries that discriminate against U.S. firms as published by the USTR; and
- 3) has not entered into any subcontract for any product to be used on the Federal project that is produced in a foreign country included on the list of countries that discriminate against U.S. firms published by the USTR.

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 USC Section 1001.

The Offeror/Contractor must provide immediate written notice to the Owner if the Offeror/Contractor learns that its certification or that of a subcontractor was erroneous when submitted or has become erroneous by reason of changed circumstances. The Contractor must require subcontractors provide immediate written notice to the Contractor if at any time it learns that its certification was erroneous by reason of changed circumstances.

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 an Offeror or subcontractor:

- 1) who is owned or controlled by one or more citizens or nationals of a foreign country included on the list of countries that discriminate against U.S. firms published by the USTR or
- 2) whose subcontractors are owned or controlled by one or more citizens or nationals of a foreign country on such USTR list or
- 3) who incorporates in the public works project any product of a foreign country on such USTR list.

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.

The Offeror agrees that, if awarded a contract resulting from this solicitation, it will incorporate this provision for certification without modification in all lower tier subcontracts. The Contractor may rely on the certification of a prospective subcontractor that it is not a firm from a foreign country included on the list of countries that discriminate against U.S. firms as published by USTR, unless the Offeror has knowledge that the certification is erroneous.

This certification is a material representation of fact upon which reliance was placed when making an award. If it is later determined that the Contractor or subcontractor knowingly rendered an erroneous certification, the Federal Aviation Administration (FAA) may direct through the Owner cancellation of the contract or subcontract for default at no cost to the Owner or the FAA.

A27 VETERAN’S PREFERENCE

A27.1 SOURCE

49 USC § 47112(c)

A27.2 APPLICABILITY

Contract Types – This provision applies to all AIP funded projects that involve labor to carry out the project. This preference, which excludes executive, administrative, and supervisory positions, applies to covered veterans (as defined under § 47112(c)) only when they are readily available and qualified to accomplish the work required by the project.

Use of Provision – No mandatory text provided. The following language is acceptable to the FAA and meets the intent of this requirement. If the sponsor uses different language, the sponsor’s language must fully satisfy the requirements of 49 USC § 47112.

A27.3 CONTRACT CLAUSE

VETERAN’S PREFERENCE

In the employment of labor (excluding executive, administrative, and supervisory positions), the Contractor and all sub-tier contractors must give preference to covered veterans as defined within Title 49 United States Code Section 47112. Covered veterans include Vietnam-era veterans, Persian Gulf veterans, Afghanistan-Iraq war veterans, disabled veterans, and small business concerns (as defined by 15 USC 632) owned and controlled by disabled veterans. This preference only applies when there are covered veterans readily available and qualified to perform the work to which the employment relates.

FEDERAL / STATE CONTRACT PROVISIONS

**DAVIS BACON
WAGE RATES**

“Building”

CHARLOTTE COUNTY

General Decision Number: FL20230198 01/13/2023
Superseded General Decision Number: FL20220198
State: Florida
Construction Type: Building

County: Charlotte County in Florida.

BUILDING CONSTRUCTION PROJECTS (does not include single family homes or apartments up to and including 4 stories).

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658.

Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	Executive Order 14026 generally applies to the contract. The contractor must pay all covered workers at least \$16.20 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2023.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or all extended on or after January 30, 2022:	Executive Order 13658 generally applies to the contract. The contractor must pay covered workers at least \$12.15 per hour (or the applicable wage rate on this wage if it is higher) for all hours spent performing on that contract in 2023.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at <http://www.dol.gov/whd/govcontracts>.

Modification Number	Publication Date
0	01/06/2023
1	01/13/2023

ASBE0067-003 01/01/2021

	Rates	Fringes
ASBESTOS WORKER/HEAT & FROST INSULATOR.....	\$ 30.12	13.11

ELEC0915-005 12/05/2022		

	Rates	Fringes
ELECTRICIAN (Includes Low Voltage Wiring).....	\$ 29.74	42%+\$0.35

* ELEV0074-001 01/01/2023		

	Rates	Fringes
ELEVATOR MECHANIC.....	\$ 47.51	37.335+a+b

FOOTNOTE:

a. Employer contributions 8% of regular hourly rate to vacation pay credit for employee who has worked in business more than 5 years; Employer contributions 6% of regular hourly rate to vacation pay credit for employee who has worked in business less than 5 years.

b.Paid Holidays: New Year's Day; Memorial Day; Independence Day; Labor Day; Veterans' Day, Thanksgiving Day; The Friday after Thanksgiving Day; and Christmas Day.

ENGI0487-021 07/01/2016

	Rates	Fringes
OPERATOR: Crane		
All Cranes 160 Ton		
Capacity and Over.....	\$ 33.05	9.20
All Cranes Over 15 Ton		
Capacity.....	\$ 32.05	9.20
OPERATOR: Forklift.....	\$ 23.25	9.20
OPERATOR: Mechanic.....	\$ 32.05	9.20
OPERATOR: Oiler.....	\$ 23.50	9.20

IRON0397-007 07/01/2022

	Rates	Fringes
IRONWORKER, STRUCTURAL.....	\$ 32.60	16.97

IRON0402-001 10/01/2021

	Rates	Fringes
IRONWORKER, ORNAMENTAL.....	\$ 25.50	14.66

* SUFL2014-006 08/16/2016

	Rates	Fringes
CARPENTER.....	\$ 19.78	8.05
CEMENT MASON/CONCRETE FINISHER...	\$ 14.85 **	0.60
IRONWORKER, REINFORCING.....	\$ 26.37	12.65
LABORER: Common or General, Including Cement Mason Tending...	\$ 13.00 **	0.00
LABORER: Pipelayer.....	\$ 14.00 **	1.40

OPERATOR:		
Backhoe/Excavator/Trackhoe.....	\$ 22.07	8.80
OPERATOR: Bulldozer.....	\$ 15.40 **	1.90
OPERATOR: Grader/Blade.....	\$ 18.97	0.00
OPERATOR: Loader.....	\$ 14.00 **	1.40
OPERATOR: Roller.....	\$ 14.43 **	4.78
PAINTER: Brush, Roller and		
Spray.....	\$ 14.72 **	2.13
PIPEFITTER, Includes HVAC		
Pipe Installation.....	\$ 20.59	7.49
PLUMBER.....	\$ 21.14	8.11
ROOFER.....	\$ 19.00	1.17
SHEET METAL WORKER, Includes		
HVAC Duct Installation.....	\$ 19.05	4.47
SPRINKLER FITTER (Fire		
Sprinklers).....	\$ 21.86	7.94
TILE SETTER.....	\$ 18.01	0.00
TRUCK DRIVER: Dump Truck.....	\$ 13.22 **	2.12
TRUCK DRIVER: Lowboy Truck.....	\$ 14.24 **	0.00

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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** Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 (\$16.20) or 13658 (\$12.15). Please see the Note at the top of the wage determination for more information.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year.

Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at <https://www.dol.gov/agencies/whd/government-contracts>.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than "SU" or "UAVG" denotes that the union

classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the "SU" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010

08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour National Office because National Office has responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION

**DAVIS BACON
WAGE RATES**

“Highway”

CHARLOTTE COUNTY

General Decision Number: FL20230161 01/06/2023
Superseded General Decision Number: FL20220161
State: Florida
Construction Type: Highway

County: Charlotte County in Florida.

HIGHWAY CONSTRUCTION PROJECTS

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658.

Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	Executive Order 14026 generally applies to the contract. The contractor must pay all covered workers at least \$16.20 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2023.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or all extended on or after January 30, 2022:	Executive Order 13658 generally applies to the contract. The contractor must pay covered workers at least \$12.15 per hour (or the applicable wage rate on this wage if it is higher) for all hours spent performing on that contract in 2023.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at <http://www.dol.gov/whd/govcontracts>.

Modification Number	Publication Date
0	01/06/2023

SUFL2013-022 08/19/2013

	Rates	Fringes
CARPENTER, Includes Form Work.....	\$ 14.42 **	0.00
CEMENT MASON/CONCRETE FINISHER....	\$ 15.12 **	0.00
ELECTRICIAN.....	\$ 21.80	0.00
HIGHWAY/PARKING LOT STRIPING:		
Operator (Striping Machine).....	\$ 16.79	0.00
HIGHWAY/PARKING LOT STRIPING:		
Painter.....	\$ 12.13 **	0.00
IRONWORKER, ORNAMENTAL.....	\$ 13.48 **	0.00
IRONWORKER, REINFORCING.....	\$ 16.39	0.00
IRONWORKER, STRUCTURAL.....	\$ 16.42	0.00
LABORER (Traffic Control Specialist).....	\$ 10.31 **	0.00
LABORER: Asphalt, Includes Raker, Shoveler, Spreader and Distributor.....	\$ 13.89 **	0.00

LABORER: Common or General.....	\$ 10.90 **	0.00
LABORER: Flagger.....	\$ 11.77 **	0.00
LABORER: Grade Checker.....	\$ 15.88 **	0.00
LABORER: Mason Tender - Cement/Concrete.....	\$ 12.93 **	0.00
LABORER: Pipelayer.....	\$ 13.63 **	0.00
OPERATOR: Asphalt Spreader.....	\$ 14.75 **	0.00
OPERATOR: Backhoe/Excavator/Trackhoe.....	\$ 16.15 **	0.00
OPERATOR: Bobcat/Skid Steer/Skid Loader.....	\$ 12.88 **	0.00
OPERATOR: Broom/Sweeper.....	\$ 13.69 **	0.00
OPERATOR: Bulldozer.....	\$ 17.14	0.00
OPERATOR: Concrete Finishing Machine.....	\$ 15.44 **	0.00
OPERATOR: Crane.....	\$ 21.69	0.00
OPERATOR: Curb Machine.....	\$ 19.67	0.00
OPERATOR: Drill.....	\$ 14.78 **	0.00
OPERATOR: Forklift.....	\$ 12.58 **	0.00
OPERATOR: Gradall.....	\$ 14.71 **	0.00
OPERATOR: Grader/Blade.....	\$ 20.34	0.00
OPERATOR: Loader.....	\$ 18.00	1.93
OPERATOR: Mechanic.....	\$ 17.86	0.00
OPERATOR: Milling Machine.....	\$ 16.09 **	0.00

OPERATOR: Oiler.....	\$ 17.31	0.00
OPERATOR: Paver (Asphalt, Aggregate, and Concrete).....	\$ 16.82	0.00
OPERATOR: Piledriver.....	\$ 17.23	0.00
OPERATOR: Post Driver (Guardrail/Fences).....	\$ 19.35	0.00
OPERATOR: Roller.....	\$ 14.37 **	0.00
OPERATOR: Scraper.....	\$ 11.74 **	0.00
OPERATOR: Screed.....	\$ 16.67	0.00
OPERATOR: Trencher.....	\$ 16.07 **	0.66
PAINTER: Spray.....	\$ 16.38	0.00
TRUCK DRIVER: Dump Truck.....	\$ 15.06 **	0.00
TRUCK DRIVER: Flatbed Truck.....	\$ 14.13 **	0.00
TRUCK DRIVER: Lowboy Truck.....	\$ 17.07	0.00
TRUCK DRIVER: Slurry Truck.....	\$ 11.96 **	0.00
TRUCK DRIVER: Water Truck.....	\$ 14.16 **	0.00

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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** Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 (\$16.20) or 13658 (\$12.15). Please see the Note at the top of the wage determination for more information.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is

awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year.

Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at <https://www.dol.gov/agencies/whd/government-contracts>.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than "SU" or "UAVG" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union

which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the "SU" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in

producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour National Office because National Office has responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour

Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7).
Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION

FAA MANDATORY REQUIREMENTS

**FAA MANDATORY REQUIREMENTS
AIP REQUIRED CONTRACT PROVISIONS**

November 18, 2022

ACCESS TO RECORDS AND REPORTS

Applies to all AIP funded projects
(2 CFR § 200.334, 2 CFR § 200.337, FAA Order 5100.38)

The Contractor must maintain an acceptable cost accounting system. The Contractor agrees to provide the Owner, the Federal Aviation Administration and the Comptroller General of the United States or any of their duly authorized representatives access to any books, documents, papers and records of the Contractor which are directly pertinent to the specific contract for the purpose of making audit, examination, excerpts and transcriptions. The Contractor agrees to maintain all books, records and reports required under this contract for a period of not less than three years after final payment is made and all pending matters are closed.

**NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION to
ENSURE EQUAL EMPLOYMENT OPPORTUNITY**

Applies to AIP funded projects exceeding \$10,000
(41 CFR part 60-4, Executive Order 11246)

1. The Offeror's or Bidder's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Opportunity Construction Contract Specifications" set forth herein.
2. The goals and timetables for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

Timetables

Goals for minority participation for each trade: **17.1%**
Goals for female participation in each trade: 6.9%

These goals are applicable to all of the Contractor's construction work (whether or not it is Federal or federally assisted) performed in the covered area. If the Contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for such geographical area where the work is actually performed. With regard to this second area, the Contractor also is subject to the goals for both its federally involved and non-federally involved construction.

The Contractor's compliance with the Executive Order and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR 60-4.3(a) and its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the Contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, the Executive Order and the regulations in 41 CFR Part 60-4.

Compliance with the goals will be measured against the total work hours performed.

3. The Contractor shall provide written notification to the Director of the Office of Federal Contract Compliance Programs (OFCCP) within 10 working days of award of any construction subcontract in excess of \$10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the name, address, and telephone number of the subcontractor; employer identification number of the subcontractor; estimated dollar amount of the subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the subcontract is to be performed.

4. As used in this notice and in the contract resulting from this solicitation, the “covered area” is **Florida, Charlotte County, Punta Gorda.**

BREACH OF CONTRACT TERMS

Applies to AIP funded projects exceeding \$250,000
(2 CFR § 200 Appendix II(A))

Any violation or breach of terms of this contract on the part of the *Contractor* or its subcontractors may result in the suspension or termination of this contract or such other action that may be necessary to enforce the rights of the parties of this agreement.

Owner will provide *Contractor* written notice that describes the nature of the breach and corrective actions the *Contractor* must undertake in order to avoid termination of the contract. Owner reserves the right to withhold payments to Contractor until such time the Contractor corrects the breach or the Owner elects to terminate the contract. The Owner’s notice will identify a specific date by which the *Contractor* must correct the breach. Owner may proceed with termination of the contract if the *Contractor* fails to correct the breach by the deadline indicated in the Owner’s notice.

The duties and obligations imposed by the Contract Documents and the rights and remedies available thereunder are in addition to, and not a limitation of, any duties, obligations, rights and remedies otherwise imposed or available by law.

FAA BUY AMERICAN PREFERENCE

Applies to all AIP funded projects
(49 USC § 50101)

The Contractor certifies that its bid/offer is in compliance with 49 USC § 50101, BABA and other related Made in America Laws, U.S. statutes, guidance, and FAA policies, which provide that Federal funds may not be obligated unless all iron, steel and manufactured goods used in AIP funded projects are produced in the United States, unless the Federal Aviation Administration has issued a waiver for the product; the product is listed as an Excepted Article, Material Or Supply in Federal Acquisition Regulation subpart 25.108; or is included in the FAA Nationwide Buy American Waivers Issued list.

The bidder or offeror must complete and submit the certification of compliance with FAA’s Buy American Preference, BABA and Made in America laws included herein with their bid or offer. The Airport Sponsor/Owner will reject as nonresponsive any bid or offer that does not include a completed certification of compliance with FAA’s Buy American Preference and BABA.

The bidder or offeror certifies that all constructions materials, defined to mean an article, material, or supply other than an item of primarily iron or steel; a manufactured product; cement and cementitious materials; aggregates such as stone, sand, or gravel; or aggregate binding agents or additives that are or consist primarily of: non-ferrous metals; plastic and polymer-based products (including polyvinylchloride,

composite building materials, and polymers used in fiber optic cables); glass (including optic glass); lumber; or drywall used in the project are manufactured in the U.S.

GENERAL CIVIL RIGHTS PROVISIONS

Applies to all AIP funded projects
(Title 49 USC § 47123)

In all its activities within the scope of its airport program, the Contractor agrees to comply with pertinent statutes, Executive Orders, and such rules as identified in Title VI List of Pertinent Nondiscrimination Acts and Authorities to ensure that no person shall, on the grounds of race, color, national origin (including limited English proficiency), creed, sex (including sexual orientation and gender identity), age, or disability be excluded from participating in any activity conducted with or benefiting from Federal assistance.

This provision is in addition to that required by Title VI of the Civil Rights Act of 1964.

The above provision binds the Contractor and subcontractors from the bid solicitation period through the completion of the contract.

CIVIL RIGHTS – TITLE VI ASSURANCE

Applies to all AIP funded projects
(Title 49 USC § 47123, FAA Order 1400.11)

Title VI Solicitation Notice:

The **Charlotte County Airport Authority**, in accordance with the provisions of Title VI of the Civil Rights Act of 1964 (78 Stat. 252, 42 USC §§ 2000d to 2000d-4) and the Regulations, hereby notifies all bidders or offerors that it will affirmatively ensure that any contract entered into pursuant to this advertisement, disadvantaged business enterprises will be afforded full and fair opportunity to submit bids in response to this invitation and will not be discriminated against on the grounds of race, color, or national origin in consideration for an award.

Title VI List of Pertinent Nondiscrimination Acts and Authorities

During the performance of this contract, the Contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the “Contractor”) agrees to comply with the following non-discrimination statutes and authorities; including but not limited to:

- Title VI of the Civil Rights Act of 1964 (42 USC § 2000d *et seq.*, 78 stat. 252) (prohibits discrimination on the basis of race, color, national origin);
- 49 CFR part 21 (Non-discrimination in Federally-assisted programs of the Department of Transportation—Effectuation of Title VI of the Civil Rights Act of 1964);
- The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, (42 USC § 4601) (prohibits unfair treatment of persons displaced or whose property has been acquired because of Federal or Federal-aid programs and projects);
- Section 504 of the Rehabilitation Act of 1973 (29 USC § 794 *et seq.*), as amended (prohibits discrimination on the basis of disability); and 49 CFR part 27;
- The Age Discrimination Act of 1975, as amended (42 USC § 6101 *et seq.*) (prohibits discrimination on the basis of age);

- Airport and Airway Improvement Act of 1982 (49 USC § 471, Section 47123), as amended (prohibits discrimination based on race, creed, color, national origin, or sex);
- The Civil Rights Restoration Act of 1987 (PL 100-209) (broadened the scope, coverage and applicability of Title VI of the Civil Rights Act of 1964, the Age Discrimination Act of 1975 and Section 504 of the Rehabilitation Act of 1973, by expanding the definition of the terms “programs or activities” to include all of the programs or activities of the Federal-aid recipients, sub-recipients and contractors, whether such programs or activities are Federally funded or not);
- Titles II and III of the Americans with Disabilities Act of 1990, which prohibit discrimination on the basis of disability in the operation of public entities, public and private transportation systems, places of public accommodation, and certain testing entities (42 USC §§ 12131 – 12189) as implemented by U.S. Department of Transportation regulations at 49 CFR parts 37 and 38;
- The Federal Aviation Administration’s Nondiscrimination statute (49 USC § 47123) (prohibits discrimination on the basis of race, color, national origin, and sex);
- Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, which ensures nondiscrimination against minority populations by discouraging programs, policies, and activities with disproportionately high and adverse human health or environmental effects on minority and low-income populations;
- Executive Order 13166, Improving Access to Services for Persons with Limited English Proficiency, and resulting agency guidance, national origin discrimination includes discrimination because of limited English proficiency (LEP). To ensure compliance with Title VI, you must take reasonable steps to ensure that LEP persons have meaningful access to your programs (70 Fed. Reg. at 74087 to 74100);
- Title IX of the Education Amendments of 1972, as amended, which prohibits you from discriminating because of sex in education programs or activities (20 USC 1681 et seq).

Compliance with Nondiscrimination Requirements:

During the performance of this contract, the Contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the “Contractor”), agrees as follows:

1. **Compliance with Regulations:** The Contractor (hereinafter includes consultants) will comply with the Title VI List of Pertinent Nondiscrimination Acts and Authorities, as they may be amended from time to time, which are herein incorporated by reference and made a part of this contract.
2. **Nondiscrimination:** The Contractor, with regard to the work performed by it during the contract, will not discriminate on the grounds of race, color, or national origin in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The Contractor will not participate directly or indirectly in the discrimination prohibited by the Nondiscrimination Acts and Authorities, including employment practices when the contract covers any activity, project, or program set forth in Appendix B of 49 CFR part 21.
3. **Solicitations for Subcontracts, including Procurements of Materials and Equipment:** In all solicitations, either by competitive bidding or negotiation made by the Contractor for work to be performed under a subcontract, including procurements of materials, or leases of equipment, each potential subcontractor or supplier will be notified by the Contractor of the contractor’s obligations under this contract and the Nondiscrimination Acts and Authorities on the grounds of race, color, or national origin.
4. **Information and Reports:** The Contractor will provide all information and reports required by the Acts, the Regulations, and directives issued pursuant thereto and will permit access to

its books, records, accounts, other sources of information, and its facilities as may be determined by the sponsor or the Federal Aviation Administration to be pertinent to ascertain compliance with such Nondiscrimination Acts and Authorities and instructions. Where any information required of a contractor is in the exclusive possession of another who fails or refuses to furnish the information, the Contractor will so certify to the sponsor or the Federal Aviation Administration, as appropriate, and will set forth what efforts it has made to obtain the information.

5. **Sanctions for Noncompliance:** In the event of a Contractor's noncompliance with the non-discrimination provisions of this contract, the sponsor will impose such contract sanctions as it or the Federal Aviation Administration may determine to be appropriate, including, but not limited to:
 - a. Withholding payments to the Contractor under the contract until the Contractor complies; and/or
 - b. Cancelling, terminating, or suspending a contract, in whole or in part.
6. **Incorporation of Provisions:** The Contractor will include the provisions of paragraphs one through six in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Acts, the Regulations, and directives issued pursuant thereto. The Contractor will take action with respect to any subcontract or procurement as the sponsor or the Federal Aviation Administration may direct as a means of enforcing such provisions including sanctions for noncompliance. Provided, that if the Contractor becomes involved in, or is threatened with litigation by a subcontractor, or supplier because of such direction, the Contractor may request the sponsor to enter into any litigation to protect the interests of the sponsor. In addition, the Contractor may request the United States to enter into the litigation to protect the interests of the United States.

CLEAN AIR AND WATER POLLUTION CONTROL

Applies to AIP funded projects exceeding \$150,000

(2 CFR § 200, Appendix II(G), Title 42 USC § 7401 et seq, Title 33 USC § 1251 et seq)

Contractor agrees to comply with all applicable standards, orders, and regulations issued pursuant to the Clean Air Act (42 USC § 740-7671q) and the Federal Water Pollution Control Act as amended (33 USC § 1251-1387). The Contractor agrees to report any violation to the Owner immediately upon discovery. The Owner assumes responsibility for notifying the Environmental Protection Agency (EPA) and the Federal Aviation Administration.

Contractor must include this requirement in all subcontracts that exceed \$150,000.

CONTRACT WORKHOURS AND SAFETY STANDARDS ACT REQUIREMENTS

Applies to projects exceeding \$100,000

(2 CFR § 200, Appendix II(E), 2 CFR § 5.5(b), 40 USC § 3702, 40 USC § 3704)

1. Overtime Requirements.

No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic, including watchmen and guards, in any workweek in which he or she is employed on such work to work in excess

of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

2. Violation; Liability for Unpaid Wages; Liquidated Damages.

In the event of any violation of the clause set forth in paragraph (1) of this clause, the Contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (1) of this clause, in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (1) of this clause.

3. Withholding for Unpaid Wages and Liquidated Damages.

The Federal Aviation Administration (FAA) or the Owner shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (2) of this clause.

4. Subcontractors.

The Contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraphs (1) through (4) and also a clause requiring the subcontractor to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (1) through (4) of this clause.

COPELAND “ANTI-KICKBACK” ACT

Applies to AIP funded projects exceeding \$2,000
(2 CFR part 200, Appendix II(D), 29 CFR parts 3 and 5)

Contractor must comply with the requirements of the Copeland “Anti-Kickback” Act (18 USC 874 and 40 USC 3145), as supplemented by Department of Labor regulation 29 CFR part 3. Contractor and subcontractors are prohibited from inducing, by any means, any person employed on the project to give up any part of the compensation to which the employee is entitled. The Contractor and each Subcontractor must submit to the Owner, a weekly statement on the wages paid to each employee performing on covered work during the prior week. Owner must report any violations of the Act to the Federal Aviation Administration.

DAVIS-BACON REQUIREMENTS

Applies to AIP funded projects exceeding \$2,000

(2 CFR part 200, Appendix II(D), 29 CFR part 5, 49 USC § 47112(b), 40 USC § 3141-3144, 3146 & 3147)

1. Minimum Wages.

(i) All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by the Secretary of Labor under the Copeland Act (29 CFR Part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalent thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the Contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in 29 CFR § 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: *Provided*, that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under (1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the Contractor and its subcontractors at the site of the work in a prominent and accessible place where it can easily be seen by the workers.

(ii)(A) The contracting officer shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The contracting officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(1) The work to be performed by the classification requested is not performed by a classification in the wage determination;

(2) The classification is utilized in the area by the construction industry; and

(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(B) If the Contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or

disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(C) In the event the Contractor, the laborers, or mechanics to be employed in the classification, or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to subparagraphs (1)(ii) (B) or (C) of this paragraph, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the Contractor does not make payments to a trustee or other third person, the Contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, *Provided*, that the Secretary of Labor has found, upon the written request of the Contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the Contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

2. Withholding. The Federal Aviation Administration or the Sponsor shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld from the Contractor under this contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the Contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the Federal Aviation Administration may, after written notice to the Contractor, Sponsor, Applicant, or Owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

3. Payrolls and Basic Records.

(i) Payrolls and basic records relating thereto shall be maintained by the Contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker; his or her correct classification; hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in 1(b)(2)(B) of the Davis-Bacon Act); daily and weekly number of hours worked; deductions made; and

actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the Contractor shall maintain records that show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual costs incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii)(A) The Contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the Federal Aviation Administration if the agency is a party to the contract, but if the agency is not such a party, the Contractor will submit the payrolls to the applicant, Sponsor, or Owner, as the case may be, for transmission to the Federal Aviation Administration. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR § 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the payrolls shall only need to include an individually identifying number for each employee (*e.g.*, the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at <http://www.dol.gov/esa/whd/forms/wh347instr.htm> or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker and shall provide them upon request to the Federal Aviation Administration if the agency is a party to the contract, but if the agency is not such a party, the Contractor will submit them to the applicant, Sponsor, or Owner, as the case may be, for transmission to the Federal Aviation Administration, the Contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the sponsoring government agency (or the applicant, Sponsor, or Owner).

(B) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the Contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be provided under 29 CFR § 5.5(a)(3)(ii), the appropriate information is being maintained under 29 CFR § 5.5 (a)(3)(i), and that such information is correct and complete;

(2) That each laborer and mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR Part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the “Statement of Compliance” required by paragraph (3)(ii)(B) of this section.

(D) The falsification of any of the above certifications may subject the Contractor or subcontractor to civil or criminal prosecution under Section 1001 of Title 18 and Section 231 of Title 31 of the United States Code.

(iii) The Contractor or subcontractor shall make the records required under paragraph (3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the Sponsor, the Federal Aviation Administration, or the Department of Labor and shall permit such representatives to interview employees during working hours on the job. If the Contractor or subcontractor fails to submit the required records or to make them available, the Federal agency may, after written notice to the Contractor, Sponsor, applicant, or Owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR § 5.12.

4. Apprentices and Trainees.

(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman’s hourly rate) specified in the Contractor’s or subcontractor’s registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice’s level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator

determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the Contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR § 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination that provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate that is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the Contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal Employment Opportunity. The utilization of apprentices, trainees, and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR Part 30.

5. Compliance with Copeland Act Requirements.

The Contractor shall comply with the requirements of 29 CFR Part 3, which are incorporated by reference in this contract.

6. Subcontracts.

The Contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR §§ 5.5(a)(1) through (10) and such other clauses as the Federal Aviation Administration may by appropriate instructions require, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR § 5.5.

7. Contract Termination: Debarment.

A breach of the contract clauses in paragraph 1 through 10 of this section may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR § 5.12.

8. Compliance with Davis-Bacon and Related Act Requirements.

All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR Parts 1, 3, and 5 are herein incorporated by reference in this contract.

9. Disputes Concerning Labor Standards.

Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR Parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the Contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

10. Certification of Eligibility.

(i) By entering into this contract, the Contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the Contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR § 5.12(a)(1).

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR § 5.12(a)(1).

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 USC § 1001.

CERTIFICATION OF OFFERER/BIDDER REGARDING DEBARMENT

Applies to AIP funded projects exceeding \$25,000

(2 CFR part 180 (Subpart B), 2 CFR part 200, Appendix II(H), 2 CFR part 1200, DOT Order 4200.5, EO 12549 & 12689)

By submitting a bid/proposal under this solicitation, the bidder or offeror certifies that neither it nor its principals are presently debarred or suspended by any Federal department or agency from participation in this transaction.

CERTIFICATION OF LOWER TIER CONTRACTORS REGARDING DEBARMENT

The successful bidder, by administering each lower tier subcontract that exceeds \$25,000 as a "covered transaction", must verify each lower tier participant of a "covered transaction" under the project is not presently debarred or otherwise disqualified from participation in this federally assisted project. The successful bidder will accomplish this by:

1. Checking the System for Award Management at website: <http://www.sam.gov>.
2. Collecting a certification statement similar to the Certification of Offerer /Bidder Regarding Debarment, above.
3. Inserting a clause or condition in the covered transaction with the lower tier contract.

If the Federal Aviation Administration later determines that a lower tier participant failed to disclose to a higher tier participant that it was excluded or disqualified at the time it entered the covered transaction,

the FAA may pursue any available remedies, including suspension and debarment of the non-compliant participant.

DISADVANTAGED BUSINESS ENTERPRISE

Applies to AIP funded projects if \$250,000 awarded in a FY
(49 CFR part 26)

Information Submitted as a matter of bidder responsiveness:
The Owner's award of this contract is conditioned upon Bidder or Offeror satisfying the good faith effort requirements of 49 CFR §26.53.

As a condition of bid responsiveness, the Bidder or Offeror must submit the following information with its proposal on the forms provided herein:

- 1) The names and addresses of Disadvantaged Business Enterprise (DBE) firms that will participate in the contract;
- 2) A description of the work that each DBE firm will perform;
- 3) The dollar amount of the participation of each DBE firm listed under (1)
- 4) Written statement from Bidder or Offeror that attests their commitment to use the DBE firm(s) listed under (1) to meet the Owner's project goal;
- 5) Written confirmation from each listed DBE firm that it is participating in the contract in the kind and amount of work provided in the prime contractor's commitment; and
- 6) If Bidder or Offeror cannot meet the advertised project DBE goal, evidence of good faith efforts undertaken by the Bidder or Offeror as described in appendix A to 49 CFR part 26. The documentation of good faith efforts must include copies of each DBE and non-DBE subcontractor quote submitted to the bidder when a non-DBE subcontractor was selected over a DBE for work on the contract.

Contract Assurance (§ 26.13) –

The Contractor or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The Contractor shall carry out applicable requirements of 49 CFR part 26 in the award and administration of Department of Transportation-assisted contracts. Failure by the Contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the Owner deems appropriate, which may include, but is not limited to:

- 1) Withholding monthly progress payments;
- 2) Assessing sanctions;
- 3) Liquidated damages; and/or
- 4) Disqualifying the Contractor from future bidding as non-responsible.

Prompt Payment (49 CFR §26.29) –

The prime contractor agrees to pay each subcontractor under this prime contract for satisfactory performance of its contract no later than **30** days from the receipt of each payment the prime contractor

receives from **Owner**. The prime contractor agrees further to return retainage payments to each subcontractor within **30** 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.

Termination of DBE Subcontracts (49 CFR § 26.53(f)) –

The prime contractor must not terminate a DBE subcontractor listed in response to **Page 13, clause 3 of the FAA Mandatory Requirements** (or an approved substitute DBE firm) without prior written consent of **Owner**. This includes, but is not limited to, instances in which the prime contractor seeks to perform work originally designated for a DBE subcontractor with its own forces or those of an affiliate, a non-DBE firm, or with another DBE firm.

The prime contractor shall utilize the specific DBEs listed to perform the work and supply the materials for which each is listed unless the contractor obtains written consent **Owner**. Unless **Owner** consent is provided, the prime contractor shall not be entitled to any payment for work or material unless it is performed or supplied by the listed DBE.

Owner may provide such written consent only if **Owner** agrees, for reasons stated in the concurrence document, that the prime contractor has good cause to terminate the DBE firm. For purposes of this paragraph, good cause includes the circumstances listed in 49 CFR §26.53.

Before transmitting to **Owner** its request to terminate and/or substitute a DBE subcontractor, the prime contractor must give notice in writing to the DBE subcontractor, with a copy to **Owner**, of its intent to request to terminate and/or substitute, and the reason for the request.

The prime contractor must give the DBE five days to respond to the prime contractor's notice and advise **Owner** and the contractor of the reasons, if any, why it objects to the proposed termination of its subcontract and why **Owner** should not approve the prime contractor's action. If required in a particular case as a matter of public necessity (e.g., safety), **Owner** may provide a response period shorter than five days.

In addition to post-award terminations, the provisions of this section apply to preaward deletions of or substitutions for DBE firms put forward by offerors in negotiated procurements.

TEXTING WHEN DRIVING
Applies to projects exceeding \$10,000
(Executive Order 13513, DOT Order 3902.10)

In accordance with Executive Order 13513, "Federal Leadership on Reducing Text Messaging While Driving", (10/1/2009) and DOT Order 3902.10, "Text Messaging While Driving", (12/30/2009), the Federal Aviation Administration encourages recipients of Federal grant funds to adopt and enforce safety policies that decrease crashes by distracted drivers, including policies to ban text messaging while driving when performing work related to a grant or subgrant.

In support of this initiative, the Owner encourages the Contractor to promote policies and initiatives for its employees and other work personnel that decrease crashes by distracted drivers, including policies that ban text messaging while driving motor vehicles while performing work activities associated with the

project. The Contractor must include the substance of this clause in all sub-tier contracts exceeding \$10,000 that involve driving a motor vehicle in performance of work activities associated with the project.

CERTIFICATION REGARDING DOMESTIC PREFERENCES FOR PROCUREMENTS

Applies to all AIP projects
(2 CFR § 200.322, 2 CFR § 200, Appendix II(L))

The Bidder or Offeror certifies by signing and submitting this bid or proposal that, to the greatest extent practicable, the Bidder or Offeror has provided a preference for the purchase, acquisition, or use of goods, products, or materials produced in the United States (including, but not limited to, iron, aluminum, steel, cement, and other manufactured products) in compliance with 2 CFR § 200.322.

EQUAL OPPORTUNITY CLAUSE

Applies to contracts exceeding \$10,000
(2 CFR 200, Appendix II(C), 41 CFR § 60-1.4, 41 CFR § 60-4.3, Executive Order 11246)

During the performance of this contract, the Contractor agrees as follows:

(1) The Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, sexual orientation, gender identity, or national origin. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, sexual orientation, gender identity, or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff, or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.

(2) The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, or national origin.

(3) The contractor will not discharge or in any other manner discriminate against any employee or applicant for employment because such employee or applicant has inquired about, discussed, or disclosed the compensation of the employee or applicant or another employee or applicant. This provision shall not apply to instances in which an employee who has access to the compensation information of other employees or applicants as a part of such employee's essential job functions discloses the compensation of such other employees or applicants to individuals who do not otherwise have access to such information, unless such disclosure is in response to a formal complaint or charge, in furtherance of an investigation, proceeding, hearing, or action, including an investigation conducted by the employer, or is consistent with the contractor's legal duty to furnish information.

(4) The Contractor will send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, a notice to be provided by the agency contracting officer, advising the labor union or workers' representative of the Contractor's commitments under this

section 202 of Executive Order 11246 of September 24, 1965, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(5) The Contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.

(6) The Contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the contracting agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(7) In the event of the Contractor's noncompliance with the nondiscrimination clauses of this contract or with any such rules, regulations, or orders, this contract may be canceled, terminated, or suspended in whole or in part and the Contractor may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

(8) The Contractor will include the provisions of paragraphs (1) through (8) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The Contractor will take such action with respect to any subcontract or purchase order as may be directed by the Secretary of Labor as a means of enforcing such provisions, including sanctions for noncompliance: *Provided*, however, that in the event the contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction, the Contractor may request the United States to enter into such litigation to protect the interests of the United States.

STANDARD FEDERAL EQUAL EMPLOYMENT OPPORTUNITY CONSTRUCTION CONTRACT SPECIFICATIONS

1. As used in these specifications:

- a. "Covered area" means the geographical area described in the solicitation from which this contract resulted;
- b. "Director" means Director, Office of Federal Contract Compliance Programs (OFCCP), U.S. Department of Labor, or any person to whom the Director delegates authority;
- c. "Employer identification number" means the Federal social security number used on the Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941;
- d. "Minority" includes:
 - (1) Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);
 - (2) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin regardless of race);

(3) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); and

(4) American Indian or Alaskan native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).

2. Whenever the Contractor, or any subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of \$10,000 the provisions of these specifications and the Notice which contains the applicable goals for minority and female participation and which is set forth in the solicitations from which this contract resulted.

3. If the Contractor is participating (pursuant to 41 CFR part 60-4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area (including goals and timetables) shall be in accordance with that Plan for those trades which have unions participating in the Plan. Contractors shall be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each contractor or subcontractor participating in an approved plan is individually required to comply with its obligations under the EEO clause and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other contractors or subcontractors toward a goal in an approved Plan does not excuse any covered contractor's or subcontractor's failure to take good faith efforts to achieve the Plan goals and timetables.

4. The Contractor shall implement the specific affirmative action standards provided in paragraphs 7a through 7p of these specifications. The goals set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. Covered construction contractors performing construction work in a geographical area where they do not have a Federal or federally assisted construction contract shall apply the minority and female goals established for the geographical area where the work is being performed. Goals are published periodically in the Federal Register in notice form, and such notices may be obtained from any Office of Federal Contract Compliance Programs office or from Federal procurement contracting officers. The Contractor is expected to make substantially uniform progress in meeting its goals in each craft during the period specified.

5. Neither the provisions of any collective bargaining agreement nor the failure by a union with whom the Contractor has a collective bargaining agreement to refer either minorities or women shall excuse the Contractor's obligations under these specifications, Executive Order 11246, or the regulations promulgated pursuant thereto.

6. In order for the non-working training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees shall be employed by the Contractor during the training period and the Contractor shall have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees shall be trained pursuant to training programs approved by the U.S. Department of Labor.

7. The Contractor shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of the Contractor's compliance with these specifications shall be based upon its effort to

achieve maximum results from its actions. The Contractor shall document these efforts fully and shall implement affirmative action steps at least as extensive as the following:

- a. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the Contractor's employees are assigned to work. The Contractor, where possible, will assign two or more women to each construction project. The Contractor shall specifically ensure that all foremen, superintendents, and other onsite supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities.
- b. Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.
- c. Maintain a current file of the names, addresses, and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source, or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this shall be documented in the file with the reason therefore along with whatever additional actions the Contractor may have taken.
- d. Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person or female sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.
- e. Develop on-the-job training opportunities and/or participate in training programs for the area which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under 7b above.
- f. Disseminate the Contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting its EEO obligations; by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.
- g. Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination, or other employment decisions, including specific review of these items, with onsite supervisory personnel such superintendents, general foremen, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.

- h. Disseminate the Contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the Contractor's EEO policy with other contractors and subcontractors with whom the Contractor does or anticipates doing business.
 - i. Direct its recruitment efforts, both oral and written, to minority, female, and community organizations, to schools with minority and female students; and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the Contractor shall send written notification to organizations, such as the above, describing the openings, screening procedures, and tests to be used in the selection process.
 - j. Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer, and vacation employment to minority and female youth both on the site and in other areas of a contractor's workforce.
 - k. Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR part 60-3.
 - l. Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel, for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.
 - m. Ensure that seniority practices, job classifications, work assignments, and other personnel practices do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the EEO policy and the Contractor's obligations under these specifications are being carried out.
 - n. Ensure that all facilities and company activities are non-segregated except that separate or single user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.
 - o. Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.
 - p. Conduct a review, at least annually, of all supervisor's adherence to and performance under the Contractor's EEO policies and affirmative action obligations.
8. Contractors are encouraged to participate in voluntary associations, which assist in fulfilling one or more of their affirmative action obligations (7a through 7p). The efforts of a contractor association, joint contractor union, contractor community, or other similar groups of which the Contractor is a member and participant may be asserted as fulfilling any one or more of its obligations under 7a through 7p of these specifications provided that the Contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female workforce participation, makes a good faith effort to meet its individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply, however, is the Contractor's and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.

9. A single goal for minorities and a separate single goal for women have been established. The Contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, if the particular group is employed in a substantially disparate manner (for example, even though the Contractor has achieved its goals for women generally), the Contractor may be in violation of the Executive Order if a specific minority group of women is underutilized.
10. The Contractor shall not use the goals and timetables or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.
11. The Contractor shall not enter into any subcontract with any person or firm debarred from Government contracts pursuant to Executive Order 11246.
12. The Contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination, and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Office of Federal Contract Compliance Programs. Any contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.
13. The Contractor, in fulfilling its obligations under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in paragraph 7 of these specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR part 60-4.8.
14. The Contractor shall designate a responsible official to monitor all employment related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the Government, and to keep records. Records shall at least include for each employee, the name, address, telephone number, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status (e.g., mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.
15. Nothing herein provided shall be construed as a limitation upon the application of other laws which establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g. those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

FEDERAL FAIR LABOR STANDARDS ACT

Applies to all AIP projects

(29 USC § 201, et seq, 2 CFR § 200.430)

All contracts and subcontracts that result from this solicitation incorporate by reference the provisions of 29 CFR part 201, the Federal Fair Labor Standards Act (FLSA), with the same force and effect as if given

in full text. The FLSA sets minimum wage, overtime pay, recordkeeping, and child labor standards for full and part-time workers.

The *Contractor* has full responsibility to monitor compliance to the referenced statute or regulation. The *Contractor* must address any claims or disputes that arise from this requirement directly with the U.S. Department of Labor – Wage and Hour Division.

TRADE RESTRICTION CERTIFICATION

Applies to all AIP projects

(49 USC § 50104, 49 CFR § Part 30)

By submission of an offer, the Offeror certifies that with respect to this solicitation and any resultant contract, the Offeror –

- 1) is not owned or controlled by one or more citizens of a foreign country included in the list of countries that discriminate against U.S. firms as published by the Office of the United States Trade Representative (USTR);
- 2) has not knowingly entered into any contract or subcontract for this project with a person that is a citizen or national of a foreign country included on the list of countries that discriminate against U.S. firms as published by the USTR; and
- 3) has not entered into any subcontract for any product to be used on the Federal project that is produced in a foreign country included on the list of countries that discriminate against U.S. firms published by the USTR.

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 USC § 1001.

The Offeror/Contractor must provide immediate written notice to the Owner if the Offeror/Contractor learns that its certification or that of a subcontractor was erroneous when submitted or has become erroneous by reason of changed circumstances. The Contractor must require subcontractors provide immediate written notice to the Contractor if at any time it learns that its certification was erroneous by reason of changed circumstances.

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 an Offeror or subcontractor:

- 1) who is owned or controlled by one or more citizens or nationals of a foreign country included on the list of countries that discriminate against U.S. firms published by the USTR; or
- 2) whose subcontractors are owned or controlled by one or more citizens or nationals of a foreign country on such USTR list; or
- 3) who incorporates in the public works project any product of a foreign country on such USTR list.

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.

The Offeror agrees that, if awarded a contract resulting from this solicitation, it will incorporate this provision for certification without modification in all lower tier subcontracts. The Contractor may rely on the certification of a prospective subcontractor that it is not a firm from a foreign country included on the list of countries that discriminate against U.S. firms as published by USTR, unless the Offeror has knowledge that the certification is erroneous.

This certification is a material representation of fact upon which reliance was placed when making an award. If it is later determined that the Contractor or subcontractor knowingly rendered an erroneous certification, the Federal Aviation Administration (FAA) may direct through the Owner cancellation of the contract or subcontract for default at no cost to the Owner or the FAA.

CERTIFICATION REGARDING LOBBYING

Applies to contracts exceeding \$100,000

(31 USC § 1352 – Byrd Anti-Lobbying Amendment, 2 CFR part 200, Appendix II(I), 49 CFR part 20, Appendix A)

The Bidder or Offeror certifies by signing and submitting this bid or proposal, to the best of his or her knowledge and belief, that:

- (1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the Bidder or Offeror, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
- (2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, “Disclosure Form to Report Lobbying,” in accordance with its instructions.
- (3) The undersigned shall require that the language of this certification be included in the award documents for all sub-awards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all sub-recipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

OCCUPATIONAL SAFETY AND HEALTH ACT

Applies to all AIP Contracts
(29 CFR part 1910)

All contracts and subcontracts that result from this solicitation incorporate by reference the requirements of 29 CFR Part 1910 with the same force and effect as if given in full text. The employer must provide a work environment that is free from recognized hazards that may cause death or serious physical harm to the employee. The employer retains full responsibility to monitor its compliance and their subcontractor's compliance with the applicable requirements of the Occupational Safety and Health Act of 1970 (20 CFR Part 1910). The employer must address any claims or disputes that pertain to a referenced requirement directly with the U.S. Department of Labor – Occupational Safety and Health Administration.

PROHIBITION ON CERTAIN TELECOMMUNICATIONS AND VIDEO SURVEILLANCE SERVICES OR EQUIPMENT

Applies to all AIP Contracts
(2 CFR § 200, Appendix II(K), 2 CFR § 200.216)

Contractor and Subcontractor agree to comply with mandatory standards and policies relating to use and procurement of certain telecommunications and video surveillance services or equipment in compliance with the National Defense Authorization Act [Public Law 115-232 § 889(f)(1)].

PROHIBITION OF SEGREGATED FACILITIES

Applies to all AIP Contracts
(2 CFR Part 200, Appendix II(C), 41 CFR § 60-1)

(a) The Contractor agrees that it does not and will not maintain or provide for its employees any segregated facilities at any of its establishments, and that it does not and will not permit its employees to perform their services at any location under its control where segregated facilities are maintained. The Contractor agrees that a breach of this clause is a violation of the Equal Employment Opportunity clause in this contract.

(b) “Segregated facilities,” as used in this clause, means any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees that are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, sex, or national origin because of written or oral policies or employee custom. The term does not include separate or single-user rest rooms or necessary dressing or sleeping areas provided to assure privacy between the sexes.

(c) The Contractor shall include this clause in every subcontract and purchase order that is subject to the Equal Employment Opportunity clause of this contract.

PROCUREMENT OF RECOVERED MATERIALS

Applies to contracts exceeding \$10,000

(2 CFR § 200.323, 2 CFR § 200, Appendix II(J), 40 CFR § 247, 42 USC § 6901, et seq (RCRA))

Contractor and subcontractor agree to comply with Section 6002 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act, and the regulatory provisions of 40 CFR Part 247. In the performance of this contract and to the extent practicable, the Contractor and subcontractors are to use products containing the highest percentage of recovered materials for items designated by the Environmental Protection Agency (EPA) under 40 CFR Part 247 whenever:

- 1) The contract requires procurement of \$10,000 or more of a designated item during the fiscal year;
or
- 2) The contractor has procured \$10,000 or more of a designated item using Federal funding during the previous fiscal year.

The list of EPA-designated items is available at www.epa.gov/smm/comprehensive-procurement-guidelines-construction-products.

Section 6002(c) establishes exceptions to the preference for recovery of EPA-designated products if the contractor can demonstrate the item is:

- a) Not reasonably available within a timeframe providing for compliance with the contract performance schedule;
- b) Fails to meet reasonable contract performance requirements; or
- c) Is only available at an unreasonable price.

CERTIFICATION OF OFFERER/BIDDER REGARDING TAX DELINQUENCY AND FELONY CONVICTIONS

Applies to all AIP Contracts

(DOT Order 4200.6)

The applicant must complete the following two certification statements. The applicant must indicate its current status as it relates to tax delinquency and felony conviction by inserting a checkmark (✓) in the space following the applicable response. The applicant agrees that, if awarded a contract resulting from this solicitation, it will incorporate this provision for certification in all lower tier subcontracts.

Certifications

- 3) The applicant represents that it is () is not () a corporation that has any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability.
- 4) The applicant represents that it is () is not () is not a corporation that was convicted of a criminal violation under any Federal law within the preceding 24 months.

Note

If an applicant responds in the affirmative to either of the above representations, the applicant is ineligible to receive an award unless the sponsor has received notification from the agency suspension and debarment official (SDO) that the SDO has considered suspension or debarment and determined that further action is not required to protect the Government's interests. The applicant therefore must provide information to the owner about its tax liability or conviction to the Owner, who will then notify the FAA Airports District Office, which will then notify the agency's SDO to facilitate completion of the required considerations before award decisions are made.

Term Definitions

Felony conviction: Felony conviction means a conviction within the preceding twenty four (24) months of a felony criminal violation under any Federal law and includes conviction of an offense defined in a section of the U.S. code that specifically classifies the offense as a felony and conviction of an offense that is classified as a felony under 18 U.S.C. § 3559.

Tax Delinquency: A tax delinquency is any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted, or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability.

TERMINATION FOR CONVENIENCE (CONSTRUCTION & EQUIPMENT CONTRACTS)

Applies to contracts exceeding \$10,000

(2 CFR § 200, Appendix II(B), FAA AC 150/5370-10, Section 80-09)

The Owner may terminate this contract in whole or in part at any time by providing written notice to the Contractor. Such action may be without cause and without prejudice to any other right or remedy of Owner. Upon receipt of a written notice of termination, except as explicitly directed by the Owner, the Contractor shall immediately proceed with the following obligations regardless of any delay in determining or adjusting amounts due under this clause:

1. Contractor must immediately discontinue work as specified in the written notice.
2. Terminate all subcontracts to the extent they relate to the work terminated under the notice.
3. Discontinue orders for materials and services except as directed by the written notice.
4. Deliver to the Owner all fabricated and partially fabricated parts, completed and partially completed work, supplies, equipment and materials acquired prior to termination of the work, and as directed in the written notice.
5. Complete performance of the work not terminated by the notice.
6. Take action as directed by the Owner to protect and preserve property and work related to this contract that Owner will take possession.

Owner agrees to pay Contractor for:

1. Completed and acceptable work executed in accordance with the contract documents prior to the effective date of termination;
2. Documented expenses sustained prior to the effective date of termination in performing work and furnishing labor, materials, or equipment as required by the contract documents in connection with uncompleted work;

3. Reasonable and substantiated claims, costs, and damages incurred in settlement of terminated contracts with Subcontractors and Suppliers; and
4. Reasonable and substantiated expenses to the Contractor directly attributable to Owner's termination action.

Owner will not pay Contractor for loss of anticipated profits or revenue or other economic loss arising out of or resulting from the Owner's termination action.

The rights and remedies this clause provides are in addition to any other rights and remedies provided by law or under this contract.

TERMINATION FOR CAUSE (CONSTRUCTION)

Section 80-09 of FAA Advisory Circular 150/5370-10 establishes standard language for conditions, rights, and remedies associated with Owner termination of this contract for cause due to default of the Contractor.

VETERAN'S PREFERENCE

49 USC § 47112(c)

In the employment of labor (excluding executive, administrative, and supervisory positions), the Contractor and all sub-tier contractors must give preference to covered veterans as defined within Title 49 United States Code Section 47112. Covered veterans include Vietnam-era veterans, Persian Gulf veterans, Afghanistan-Iraq war veterans, disabled veterans, and small business concerns (as defined by 15 USC 632) owned and controlled by disabled veterans. This preference only applies when there are covered veterans readily available and qualified to perform the work to which the employment relates.

END OF FAA MANDATORY REQUIREMENTS

FDOT MANDATORY REQUIREMENTS

FDOT MANDATORY REQUIREMENTS
Restrictions, Prohibitions, Controls and Labor Provisions

PUBLIC ENTITY CRIMES
(FS 287.133, PTGA 17(a))

A person or affiliate who has been placed on the convicted vendor list following a conviction for a public entity crime may not submit a bid, proposal, or reply on a contract to provide any goods or services to a public entity; may not submit a bid, proposal, or reply on a contract with a public entity for the construction or repair of a public building or public work; may not submit bids, proposals, or replies on leases of real property to a public entity; may not be awarded or perform work as a contractor, supplier, subcontractor, or consultant under a contract with any public entity; and may not transact business with any public entity in excess of the threshold amount provided in s. 287.017 for CATEGORY TWO for a period of 36 months following the date of being placed on the convicted vendor list.

DISCRIMINATION
(FS 287.134, PTGA 17(b))

An entity or affiliate who has been placed on the discriminatory vendor list may not submit a bid, proposal, or reply on a contract to provide any goods or services to a public entity; may not submit a bid, proposal, or reply on a contract with a public entity for the construction or repair of a public building or public work; may not submit bids, proposals, or replies on leases of real property to a public entity; may not be awarded or perform work as a contractor, supplier, subcontractor, or consultant under a contract with any public entity; and may not transact business with any public entity.

NON-RESPONSIBLE CONTRACTORS
(FS 337.165, PTGA 17(c))

An entity or affiliate who has had its Certificate of Qualification suspended, revoked, denied, or have further been determined by the Department to be a non-responsible contractor, may not submit a bid or perform work for the construction or repair of a public building or public work on a contract with the Agency.

PROHIBITION ON USING FUNDS FOR LOBBYING
(FS 216.347, PTGA 17(d))

No funds received pursuant to this Agreement may be expended for lobbying the Florida Legislature, judicial branch, or any state agency, in accordance with Section 216.347, Florida Statutes.

UNAUTHORIZED ALIENS
(Section 274A Immigration and Nationality Act, PTGA 17(e))

The Department shall consider the employment by any contractor of unauthorized aliens a violation of Section 274A(e) of the Immigration and Nationality Act. If the contractor knowingly employs unauthorized aliens, such violation will be cause for unilateral cancellation of this Agreement.

E-VERIFY COMPLIANCE
(FS 448.095, PTGA 17(g))

The Consultant, its Team, and its subcontractors shall,

- i. utilize the U.S. Department of Homeland Security's E-Verify system to verify the employment eligibility of all new employees hired by the vendor/contractor during the term of the contract; and
- ii. shall expressly require any subcontractors performing work or providing services pursuant to the state contract to likewise utilize the U.S. Department of Homeland Security's E-Verify system to verify the employment eligibility of all new employees hired by the subcontractor during the contract term.

INSPECTOR GENERAL COOPERATION
(FS 20.055(5), PTGA 19(i))

It is the duty of every state officer, employee, agency, special district, board, commission, contractor, and subcontractor to cooperate with the inspector general in any investigation, audit, inspection, review, or hearing pursuant to this section. Beginning July 1, 2015, each contract, bid, proposal, and application or solicitation for a contract shall contain a statement that the corporation, partnership, or person understands and will comply with this subsection.

END OF FDOT MANDATORY REQUIREMENTS

SPECIAL PROVISIONS

SPECIAL PROVISIONS NO. 1

CONSTRUCTION SAFETY PLAN AND SECURITY REQUIREMENTS

1. PURPOSE AND OBJECTIVE

The purpose of this plan is to set forth guidelines concerning construction and safety on the **Punta Gorda Airport** during the **South Terminal Expansion and In-Line Baggage System** project. Described herein are methods, procedures, rules and authorities to be adhered to during said construction period.

Following are the general safety plan objectives that must be achieved in order to maximize safety and to minimize time and economic loss to the aviation community, construction contractors and others directly affected by the project.

- A.** Keep the airport operational for all users.
- B.** Minimize delays to airport operations.
- C.** Maintain safety of airport operations.
- D.** Minimize delays to construction operations.
- E.** Minimize airport-operation/construction-activity conflicts.

The Contractor should keep these objectives in mind when formulating his schedules and operational activities.

2. GENERAL SAFETY REQUIREMENTS

- A.** A construction/safety meeting will be conducted after the award of the contract and prior to commencing construction. Additional construction/safety meetings may be scheduled biweekly throughout the life of the contract. Representatives from the Contractor, Architect/Engineer, Owner, and any others deemed necessary by County, will attend. The Contractor is required to conduct a weekly Safety/Security meeting and three copies of the minutes will be provided to the Architect/Engineer within five calendar days of the meeting. All supervisors and the Architect/Engineer's representative are required to attend.
- B.** The Contractor shall inform his supervisors and workmen of the airport activity and operations that are inherent to this airport, the safety regulations of the airport, and the prohibition of driving or walking on any area of the Air Operations Area (AOA) without clearance. The Contractor shall conduct his construction activities to conform to both routine and emergency requirements.
- C.** All Contractor vehicles that are authorized to operate on the airport outside of the designated construction area limits or haul routes as defined herein shall display 3' x 3' flags or larger, orange and white checkerboard flag, each checkerboard color being 1' square. Any vehicle operating during hours of darkness should be equipped with a flashing amber dome-type light, mounted on top of the vehicle and of such intensity to conform to local codes for maintenance and emergency vehicles. Vehicles operating in the active Aircraft Operational Area (AOA) must do so under with utmost caution. Aircraft traffic has the way-of-way at all time. Vehicles shall be escorted and under the control of one contractor mobile (two-way) radio operator on the job at all times.
- D.** No loose material or waste capable of causing damage to aircraft or capable of being ingested into jet engines may be placed next to the runways, taxiways or apron during operational hours. Special attention is directed to the Contractor that all pavement which is operational to aircraft during construction must be kept clean and clear of any materials or debris.

- E. Open flame torch cutting or welding is prohibited unless adequate safety precautions have been taken and approved by the Engineer.
- F. The existing airport pavements and facilities are designed for aircraft on single and dual gear configurations. The Contractor shall preserve and/or protect existing and new pavements plus other facilities from damage due to construction operations. Existing pavements and facilities which are damaged shall be replaced or reconstructed to original strength at the Contractor's expense. The Contractor shall take immediate action to reconstruct any damaged area which is to remain in service.

G. Construction Area Limits

The limits of construction, material storage area, equipment storage area, parking area and other areas defined as required for the Contractor's exclusive use during construction shall be marked by the Contractor. The Contractor shall erect and maintain around the perimeter of these areas suitable marking and warning devices visible for day/night use. Temporary fencing, barricades, flagging and/or flashing warning lights will be required at critical access points. Type of marking and warning devices shall be approved by the County, through the Engineer. Open trenches, excavations and stockpiled materials must be permanently marked with flags and lighted by approved light units during hours of reduced visibility and darkness. No separate pay item is included for this work and all costs must be included in other bid items.

Any construction activity with **250'** of an active runway centerline or **60'** from an active taxiway centerline or open excavations in excess of three inches deep within the above areas, will require closure of the affected runway or taxiway, unless otherwise approved by Airport Director, and issuance of appropriate NOTAMs. AC 150/5370-2 series, "Operational Safety on Airports during Construction", is included herein by reference.

H. Staging, Stockpile, and Spoil Areas

The staging area(s) depicted on the plans shall be used to house the Contractor's and resident inspector's offices, and to store all idle equipment, supplies, and construction materials (other than bulk materials such as aggregate, sand, and soil). The Contractor may erect and maintain throughout the life of this contract, at his expense, a 6-foot high fence of chain link fabric around the perimeter of each staging area used. He may also install vehicle and pedestrian gates, as necessary, to provide adequate ingress/egress. Additionally, the perimeter of any staging area which abuts an active operation pavement shall be marked with red flashing barricades no more than 50 feet apart. Upon completion of all work, remove all construction fencing and barricades from the project site.

Contractor's vehicles, equipment, and materials shall be stored in the area designated on the plans. Upon completion of the work, the storage area shall be cleaned up and returned to its original condition to the satisfaction of the Owner. No special payment will be made for cleanup and restoration of the storage area. Personal services will not be permitted beyond the Contractor's parking area. Drivers of vehicles being operated beyond this area shall be subject to loss of permission to enter the construction site.

Equipment not in use during construction, nights, and/or holidays will be parked in the Contractor's staging area. Exceptions will only be approved by the Engineer when absolutely necessary. Parking of construction workers' private vehicles shall also be within the staging area construction fence.

Stockpile areas shall be used to store all bulk materials needed for the project and may or may not be fenced at the Contractor's option. However, yellow flashing barricades shall be installed where potential conflicts with air or ground vehicular traffic might occur.

The spoil site depicted on the plans shall be used to stockpile all clean soil removed from the project site and not needed for the project construction. Separate stockpiles shall be created for the project construction. Separate stockpiles shall be created for structural soil and topsoil. Stockpiles shall not penetrate the FAR Part 77 imaginary surfaces. All other waste material, including rubble and debris, shall be removed from the Airport at the Contractor's expense.

No stockpile areas to store all bulk materials for the project are provided. All material removed by excavation such as concrete, asphalt, or limerock will be transported off the airport limits when it is taken up. It will not be stockpiled on airport property.

If additional storage area is needed, the Contractor may request it from the Engineer. The request will be reviewed on the basis of what is to be stored and the area needed. The Contractor shall provide any necessary fencing and/or security.

All waste material, including rubble and debris, shall be promptly removed from the Airport at the Contractor's expense. No hazardous materials shall be stored within the Airport property. Burning on Airport property is prohibited.

I. Limitation of Operations

The Contractor shall be responsible for controlling his operations and those of his subcontractors so as to provide for the free movement of aircraft in the apron and taxiway areas of the airport (Air Operations Area).

J. Obstructions to Navigation

Penetrations of the imaginary surfaces defined in FAR Part 77 shall not be permitted without advance notification of and approval by the **Owner**. It may be necessary to file Form 7460-1 with the FAA to obtain approval prior to operation of exceptionally tall equipment. This includes any penetrations whatsoever by the Contractor, including but not limited to vehicles, cranes, other construction equipment, structures, stockpiled materials, excavated earth, etc.

When penetrations are unavoidable they shall be brought to the attention of the Owner and the FAA as far in advance as is practical to allow Notices to Airmen (NOTAMS) to be prepared and distributed to appropriate FAA divisions for publication and dissemination.

During times when the safety of flight operations could be impaired, particularly during weather when instrument approaches are required, or when the equipment is idle, all booms, towers and other movable appendages shall be lowered to the maximum extent.

K. Emergency Procedures

The Contractor shall familiarize himself with airport emergency procedures and shall endeavor to conduct his operation so as not to conflict with them. Clear routes for crash/fire/rescue equipment shall be maintained in operable condition at all times.

In case of an emergency caused by an accident, fire, or personal injury or illness, local police are to be immediately notified by calling them at 911. The caller must accurately report the location and type of emergency. The Owner and Engineer shall also be notified of any emergency.

L. Access to the Construction Site

The Contractor's access to the site shall be as shown on the Project Plans or as directed by the Engineer. No other access routes shall be authorized without written approval of the Engineer and Owner.

The Contractor shall identify access routes with suitable signs, barricades and similar equipment.

All Contractor traffic authorized to enter the site shall be experienced in the route or guided by Contractor personnel. The Contractor shall be responsible for traffic control to and from the various construction areas on the site and for the operation of the access gate to the site.

The Contractor shall familiarize his employees with the route. Material and equipment delivery trucks shall be accompanied by an employee of the Contractor familiar with the route. The Contractor shall be responsible for access control through the access gate for the duration of his contract. This access control will be for all personnel using the gate for access. This gate will be manned, whenever unlocked.

The Contractor shall monitor and coordinate all Contractor traffic at the access gate with the Owner. The Contractor shall not permit any unauthorized construction personnel or traffic on the site, including food and beverage vendors or caterers.

If breaches of security occur, the Engineer may, at his option, close the gates until adequate actions have been taken to prevent further breaches of security. Any delay caused by this will be considered Contractor Caused and will not extend the contract time.

The Contractor is responsible for immediate cleanup of any debris deposited along the access route as a result of his construction traffic. The entire access route and construction site shall be kept free and clean of all debris at all times and maintained in good repair by the Contractor or his agents, and shall be immediately repaired to the satisfaction of the Owner. Directional signing along the delivery route to the storage area, plant site or work site shall be as directed by the Architect/Engineer.

M. Contractor's Security Requirements

1) General Intent: It is intended that the Contractor shall comply with all requirements of the airport security plan and with the security plan specified herein. The Contractor shall designate, to the Architect/Engineer, in writing, the name of his Contractor Security Officer (CSO). The CSO shall be the Contractor's representative on the "Construction Security Committee" and shall be accountable for these security requirements for the Contractor.

2) Contractor Security Personnel Orientation: The Contractor's Security Officer (CSO) will be responsible for all safety precautions. Prior to the commencement of the work, the CSO shall provide the Architect/Engineer an outline of a proposed accident and fire protection plan for all work contemplated under the contract.

3) Identification - Personnel: The Contractor's onsite supervisory personnel shall be badged with I.D. badges provided by the **Contractor**. The Contractor shall issue and maintain a master list of personnel issued badges and it shall be available for Owner's examination during construction hours. Personnel shall wear the badge on outermost garment at all times while on the AOA. All employees of Contractor or Subcontractor requiring access to the construction site are required to be supplied with identification badges to be worn at all times while within the area. Responsibility for supply, issuance, and control of identification badges shall be that of the Contractor, through the Contractor Security Officer and the Architect/Engineer.

4) Identification - Vehicles: The Contractor, through the Contractor Security Officer, shall establish and maintain a list of Contractor and Subcontractor vehicles authorized to operate on the site and shall issue a permit to each vehicle to be made available upon demand by the Architect/Engineer or any Airport Security Officer. Vehicle permits shall be assigned in a manner to assure positive identification of the unit at all times. In lieu of issuing individual vehicle permits, the CSO can require each vehicle to display a large company sign on both sides of vehicle and advise the County through the Architect/Engineer of a current list of companies authorized to enter and conduct work on the airport.

5) Employee Parking: Area for parking of the Contractor's employee's vehicles is to be designated by the Architect/Engineer. Parking shall be accomplished in straight equally spaced rows. Contractor shall organize traffic flow and parking patterns, supply traffic control signs and markings subject to approval of the Airport Operations. Maintain the parking surface and pick up trash daily. No storage will be allowed at parking site.

6) Materials Delivery to the Site: All Contractor's material orders for delivery to the work site will use as a delivery address, the street name and number assigned to the access point onto the airport. This will

preclude delivery trucks from entering into the Terminal Complex or taking short cuts through perimeter gates and entering into aircraft operations areas inadvertently.

END OF SPECIAL PROVISION NO. 1

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SPECIAL PROVISION NO. 2

AIRPORT PROJECT PROCEDURES

1. GENERAL

These Special Provisions are supplemental to the Bid Documents and the General Provisions and constitute a part of the Specifications and Contract Documents. In case of conflict between any provisions of the Project Plans and the Technical Specifications, the Technical Specifications shall govern. In case of conflict between any provisions of the Bid Documents and the General Provisions, the Bid Documents shall take precedence and govern. In case of conflict between any provisions of the Special Provisions and any other part of the Specifications and Contract Documents, the Special Provisions shall take precedence and govern.

The work herein contemplated consists of furnishing all tools, labor, plant, equipment, materials, and performing all work necessary for a completed project in strict accordance with detailed plans and the specifications.

It is the intent of these Project Plans and specifications to prescribe a complete work and improvement. Where items of work are necessary for the satisfactory completion of the contract, then such work shall be considered incidental to the work called for, and any costs involved shall be reflected in the bid unit price for the item requiring it for each alternate accepted by the Owner, if any alternates are a part of the proposal, as are provided.

2. WAGE RATES

Wage rates shall be in accordance with General Decision Numbers **FL20220161 (Hwy)**, **FL20220198 (Bldg)**, which are attached at the end of the GENERAL PROVISIONS.

No payments shall be made by the Owner until and unless the Contractor has furnished to the Owner written evidence certifying hourly wages actually paid to the workmen on this project in all applicable classifications and on forms acceptable the Owner.

3. PERMITS

Contractor shall be required to procure and pay for all construction permits, arrange for all inspections and similar procedural items as required by the code enforcement authorities having jurisdiction.

4. 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.

In order to maintain operations of the existing facilities with the minimum of interference to normal operations, the following shall be complied with by the Contractor.

- A.** The work once started shall be continued in a diligent manner until completed.
- B.** The sequencing of the work shall be as shown on the Project Layout and Phasing Plans, or as approved by the Engineer. The Contractor shall coordinate the opening or closing of any

area of pavement with the airport manager. A minimum of 48 hours notice is required to allow the owner to issue appropriate NOTAMs.

5. 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.

6. 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. Contractor is responsible to maintain these control points for use by subsequent Contractors.

7. 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.

8. SAFETY AND PROTECTION

- A. 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.
- B. 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.

9. 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.

10. ADMINISTRATIVE/SUPERVISORY PERSONNEL

The Contractor shall provide a full-time Project Management Team consisting of a Project Manager, Project Superintendents 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 Project Manager 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.

The Owner will not recognize any subcontractor on the work. The Contractor shall at all times, when work is in progress, be represented at the site of the work either, in person or by a qualified superintendent who shall be in direct charge of all operations on the contract, whether performed directly by the contractor, or through a subcontractor.

11. SPECIAL REPORTS

- A. **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.
- B. **Submitting Reports:** Submit special reports directly to the Owner within one (1) day of occurrence. Submit a copy of the report to the Architect/Engineer/RPR and other entities that are affected by the occurrence within one day of the occurrence.

12. TAXES

All applicable taxes whether Federal, State, Local or other shall be included in the Contractors Bid.

13. INSURANCE REQUIREMENTS

- A. **General:** The bidder shall provide with the Proposal a copy of a Certificate of Insurance as verification that the insurance coverage required is in force. This purpose of providing this certificate is only to verify that the Contractor has the coverage required. The copy of the certificate does not have to name the "additional insured". In providing the copy of the Certificate of Insurance the Contractor shall also indicate in writing whether or not the Contractor's insurance does, can and/or will provide coverage for his Subcontractors or if the Contractor's Subcontractors will have to be covered by their individual policy(ies) in accordance with the requirements of this document. The bidder shall be responsible to include in his **Unit Price Bid Prices** any additional costs of insurance related to either his policy(ies) covering the Subcontractors or the "additional insured".

A bidder who does not currently have in force the insurance coverage required may submit with his/her bid a notarized affidavit from the insurance provider who will provide the required insurance coverage. The affidavit shall state that in the event the bidder is awarded the contract for this project the insurance provider will provide the insurance coverage required in these documents. Said statement shall also indicate whether or not the Contractor's insurance will provide coverage for the Contractor's Subcontractors or if the Contractor's Subcontractors will have to be covered by their individual policy(ies) in accordance with the requirements of these documents. In this case the bidder shall be responsible for obtaining from his/her insurance provider the amount of any additional cost to provide the required insurance coverage and any additional cost that his/her Subcontractors will incur

to provide their separate coverage and the total cost of the insurance required shall be included in the bidder's **Unit Price Bids**.

14. **CLEAN AIR AND CLEAN WATER ACTS**

In addition to the requirements listed in the General Provisions, the Contractor is responsible for compliance with all applicable standards, orders, or requirements issued under Section 306 of the Clean Air Act, Section 505 of the Clean Water Act, Executive Order 11738, and Environmental Protection Agency regulations.

15. **PROJECT SCHEDULE**

The Contractor shall prepare a Project Work Schedule and provide it to the Architect and/or Engineer at the Pre-Construction Conference for review and approval. The Project Work Schedule must be practicable and feasible, showing the order in which the contractor proposes to carry on the work, the approximate dates on which he will start salient features and the contemplated dates for completing same.

16. **CHANGES IN THE SCHEDULE**

- A. **Minor Changes:** Each week, prior to the weekly coordination meeting during the time of the contract, the Contractor shall notify the Owner's Representative of any minor changes that are anticipated in the schedule for the following week.
- B. **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.

17. **MAINTENANCE OF TRAFFIC**

- A. **Maintenance Responsibilities:** 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.
- B. **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.
- C. **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.
- D. **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.
- E. **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 six-inch (6") high messages and shall be

located at each decision point. All signs and their locations shall be approved by the Engineer and Owner. NO OTHER SIGNS ARE PERMITTED.

- F. **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.
- G. **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.
- H. **Delivery Address:** All Contractor's material orders for delivery to the work site will use as a delivery address, the street name and number assigned to the access point onto the airport. The name "PUNTA GORDA AIRPORT" shall not be used in the delivery address at any time. This will preclude delivery trucks from entering into aircraft operations areas inadvertently. 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.

I. Interference Request:

- 1) The Contractor shall be responsible for notifying the Owner in writing and securing approval for any and all interruptions or interference's with traffic (pedestrian, automobile or other necessary function of the Airport.)
- 2) The request shall include a traffic control plan indicating barricades, lighting and flagmen where required.
- 3) Such notification shall be made as soon as possible but in no case less than forty-eight (48) hours prior to interference.
- 4) 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.

J. Personnel Traffic:

- 1) General: All construction personnel shall be restricted to construction areas. They shall wear shirts with sleeves and long pants at all times.
- 2) 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.

18. DAILY CLEAN-UP AND TRASH REMOVAL

- A. **Daily Responsibilities:** 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.
- B. **Maintenance:** The Contractor shall be responsible for clean up and trash removal. Accumulation of trash and debris will not be allowed and the Architect/Engineer/RPR 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.

19. SITE CLEAN-UP

Before the final job is accepted by the Owner, the entire area used during construction must be cleaned of all foreign materials such as rock, wood, etc., that could be picked up by mowers used by the Airport Maintenance Crews. A thorough inspection of the area shall be made by the Architect and/or Engineer and the Contractor before final inspection of the project is made. Failure of the Contractor to clean up the job site could delay final inspection and thereby delay final completion and final payment on his contract. The cleaning up of the project work area is incidental to all other work involved, and no additional payment for this work shall be made.

20. CLEANING AND PROTECTION

- A. **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.
- B. **Frequency:** 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.
- C. **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:
 - 1) Excessive static or dynamic loading
 - 2) Excessive internal or external pressures
 - 3) Solvents
 - 4) Chemicals
 - 5) Light
 - 6) Puncture
 - 7) Abrasion
 - 8) Heavy Traffic
 - 9) Soiling
 - 10) Combustion
 - 11) High speed operation, improper lubrication, and unusual wear
 - 12) Improper shipping or handling
 - 13) Theft
 - 14) Vandalism
- D. **Protection at Openings:** The Contractor shall provide protection at all openings in structures and finishes to maintain the building weather proof 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.
- E. **Protection of Improvements:**
 - 1) **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.
 - 2) **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.

F. Overhead Protection

- 1) No cranes or other construction equipment shall cross over non-construction personnel, their travel ways or ride systems.
- 2) 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.

21. CONSERVATION AND SALVAGE

A. 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 that are the Owner's property.

B. Material to be Salvaged: All material and equipment called out in the specifications or so noted on the Project Plans that are to remain the property of the Owner will be salvaged by the Contractor and will be stored on the Airport property as directed by Owner at no additional cost. All other remaining salvageable items and all construction/demolition debris shall become the property of the Contractor and be disposed of off airport property.

22. PROJECT DOCUMENTATION

A. 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.

B. Record Documents:

- 1) 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.

- 2) 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.
 - a) 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 ½" 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.
 - b) 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 Architect/Engineer. The Architect/Engineer will then proceed with preparation of a full set of corrected transparencies for contract drawings. The Architect/Engineer will date each updated drawing and label each sheet "PROJECT RECORD" in 1½" high letters. Printing as required herein is the responsibility of the Architect/Engineer.
 - c) Copies, Distribution: Upon completion of transparency record drawings, the Architect/Engineer shall prepare three (3) blue-line or blackline prints of each drawing, regardless of whether changes and additional information were recorded thereon. The Architect/Engineer shall then organize each of the three (3) 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 Architect/Engineer will retain one copy set. At the completion of the project, the Architect/Engineer shall submit one set of mylars and one set of prints with changes noted thereon to the Owner.
- 3) Record Drawings shall contain the names, addresses and phone numbers of the General Contractor and the major subcontractors.
- 4) The Architect/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 Partial and Final Payments.

C. Record Specifications

- 1) 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 Architect/ Engineer for the Owner's records. Label the front cover "PROJECT RECORD" in 1-1/2 inch high letters.
- 2) 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.

D. Record Product Data

During progress of the work, maintain one (1) 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 that 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 Architect/Engineer for the Owner's records. Label each data submittal "PROJECT RECORD" in 1-1/2 inch high letters.

E. Record Sample Submittal

Immediately prior to the date(s) of substantial completion, the Architect/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 Architect/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 Architect/Engineer.

F. 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 Architect/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:

- 1) Required field records on excavations, foundations, underground construction, wells and similar work.
- 2) Accurate survey showing locations and elevations of all electrical items, underground lines, including invert elevations of drainage piping, valves, tanks and manholes.
- 3) Surveys by a Registered Land Surveyor establishing lines and levels of finished construction.
- 4) Soil treatment certification, if applicable.
- 5) Inspection and Test Reports where not processed as shop drawings or product data.

- 6) Asphalt or PCC pavement or structural mix design record, if applicable.
- 7) Concrete block certification, if applicable.

G. 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.

H. Prerequisites to Substantial Completion

- 1) Prior to requesting the Architect/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:
 - a) 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 incomplete work, and reasons for being incomplete.
 - b) Include supporting documentation for completion as indicated in the Contract Documents.
 - c) Submit statement showing accounting of changes to the Contract Sum.
 - d) Advise the Owner of pending insurance changeover requirements.
 - e) 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.
 - f) Deliver tools, spare parts, extra stocks of materials, and similar physical items to the Owner.
 - g) Make the final changeover of locks and transmit keys to the Owner and advise Owner's personnel of changeover in security provisions.
 - h) 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.
- 2) Upon receipt of the Contractor's request, the Architect/Engineer will proceed with inspection or advise the Contractor of prerequisites not fulfilled. Following initial inspection, the Architect/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.

I. Prerequisites to Final Acceptance

- 1) Prior to requesting the Architect/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:
 - a) Submit a certified copy of the Architect/ 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 Architect/ Engineer.
 - b) 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.
 - c) Complete final cleaning up requirements, including touch-up of marred surfaces.
 - d) Touch up and otherwise repair and restore marred exposed finishes.
- 2) Following Substantial Completion, the Contractor shall correct or remedy all Punchlist items to the satisfaction of the Architect/Engineer and Owner within a **two (2) week** period after the Date of Substantial Completion. If subsequent inspections are necessary after the one-(1) 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.

J. Prerequisites to Final Payment

- 1) Final Payment: Final Payment will be made after final acceptance of the project by the Architect/Engineer and Owner upon request by the Contractor on condition that the Contractor:
 - a) Furnish properly executed, complete releases of lien from all material men 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.
 - b) Furnish the Contractor's Affidavit of Release of Liens (2 copies) that all material men 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.
 - c) Furnish Contractor's Affidavit of Debts and Claims (2 copies).
 - d) Furnish required sets of record drawings and maintenance and operating instructions of new mechanical equipment.
 - e) Furnish guarantees signed by subcontractors, material suppliers, and countersigned by the Contractor for operating equipment.
 - f) Submit specific warranties, workmanship-maintenance bonds, maintenance agreements, final certifications and similar documents.

- g) Furnish a signed guarantee, in form acceptable to the Engineer and Owner agreeing to repair or replace as decided by the Architect/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.
- h) Furnish Consent of Surety to final payment.
- i) Submit updated final statement, accounting for final changes to Contract Sum.
- j) Submit evidence of final, continuing insurance coverage complying with insurance requirements.
- k) Certify that all Social Security, Unemployment and all other taxes (City, State, Federal Government) have been paid.
- l) Provide receipt, as applicable, of affidavits certifying all labor standards of local, State, or Federal requirements have been complied with by the Contractor.

K. 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 Architect/Engineer's reference during normal working hours.

- 1) Record Drawings: The Architect/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.
- 2) Record Specifications: Upon completion of mark-ups, submit to the Architect/Engineer for the Owner's records.
- 3) Record Product Data: Upon completion of mark-ups, submit complete sets to the Architect/Engineer for the Owner's records.
- 4) Record Sample Submittal: Comply with the Architect/ Engineer's instructions for packaging, identification, marking and delivery to the Owner's sample storage space.
- 5) 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 Architect/Engineer for the Owner's records.
- 6) Maintenance Manuals: Complete, place in order, properly identify and submit to the Architect/Engineer for the Owner's records.

L. Closeout Procedures

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, shutdown, 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.

23. FINAL CLEANING

- A. General:** 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.
- B. Removal of Protection:** Remove temporary protection devices and facilities that were installed during the course of the work to protect previous completed work during the remainder of the construction period.
- C. Compliance:** 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.

24. WARRANT AND GUARANTEE.

The Contractor warrants to the Owner that all materials furnished under this Contract shall be new unless specified otherwise and is free of defects and in conformance with the Contract requirements. Any work not so conforming to these specifications may be considered defective.

If, within one (1) year after the date of the final acceptance of the work, or within longer period of time as may be prescribed by law or by the terms of any applicable guarantee required by the Contract, any of the work is found to be defective or not in accordance with the Contract requirements, the Contractor shall correct it promptly after receipt of written notice from the Owner to do so.

The obligations of the Contractor in this paragraph titled WARRANTY AND GUARANTEE shall be in addition to and not in limitation of any obligations imposed upon him by special guarantees required by the contract or otherwise prescribed by law.

25. REVIEW AND ACCEPTANCE OF MATERIALS.

The Contractor shall furnish to the Engineer, for review, all Contractor's, subcontractor's and manufacturer's drawings, which shall be deemed to include shop material lists and performance data, which may be required by the Specifications, requested by the Engineer or otherwise necessary for the proper execution of the work. At the time of each submission, the Contractor shall in writing call the Engineer's attention to any deviation that the shop drawings may have from the requirements of the Contract documents.

Where called for, the Contractor shall furnish two (2) samples of each material, texture, color, etc., clearly labeled as to name and quality of material, manufacturer and application on the project.

No work requiring a shop drawing or sample submission shall be started until the submission has been reviewed by the Engineer.

The Engineer's review of shop drawings or sample will not relieve the Contractor from his responsibility for any deviations from the requirements of the Contract documents unless the Contractor has in writing called the Engineer's attention to such deviations at the time of submission and the Engineer has given written comments on the specific deviation, nor will it relieve the Contractor from errors or omissions in the shop drawings.

26. WORK ACCESS.

Any haul road, ditch crossing, storage area, etc., that the Contractor may required shall be constructed and maintained at the Contractor's expense and shall be removed unless otherwise noted on the project plans. The Contractor shall not use runways, taxiways or other paved areas on the air operation portions of the airport for access to and from the project site unless authorized by the Owner. No equipment or vehicle will be allowed on the air operation portions of the airport except as authorized by the Owner.

Any runways, taxiway or other paved areas damaged by the Contractor's vehicles or equipment shall be repaired by the Contractor at no cost to the Owner.

From time to time when required, the Contractor shall move Contractor's vehicles or equipment and men from along the edge of runways/taxiways/aprons to allow aircraft operations on the pavement.

27. LIENS.

Neither the final payment nor any part of the retained percentage shall become due until the Contractor, if required, delivers to the Owner a complete release of all liens arising out of this Contract, or receipts in full in lieu thereof, and if required in either case, an affidavit that so far as he has knowledge or information the releases and receipts include all labor and materials for which a lien could be filed: but the Contractor may, if any Subcontractor refuses to furnish a release or receipt in full, furnish a bond satisfactory to the Engineer, to indemnify the Owner against any lien. If any remains unsatisfied after all payment are made, the Contractor shall refund to the Owner all moneys that the latter may be compelled to pay in discharging such a lien, including all costs and a reasonable attorney's fee.

END OF SPECIAL PROVISION NO. 2

SPECIAL PROVISION NO. 3

CONSTRUCTION TIME AND LIQUIDATED DAMAGES

1. 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.

2. CONSTRUCTION TIME

- A.** 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.
- B.** The Contractor must request and receive written approval from the Engineer for acceptance of the work included in each of the schedules, phases or work prior to satisfying the requirements of being “complete”.
- C.** 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, Engineer and Contractor based upon the actual contract work awarded. The specified times for the project are identified in Table 2-1:

TABLE 2-1 CONSTRUCTION TIME AND LIQUIDATED DAMAGES

WORK PHASE	MAXIMUM CALENDAR DAYS TO COMPLETE WORK	CONTRACT DAYS WORK TO BE PERFORMED	LIQUIDATED DAMAGES PER CALENDAR DAY
Mobilization	30	1 to 60	\$ 250.00
Construction Phases	510	60 to 180	\$ 1000.00
Substantial Completion	14	180 to 195	\$ 1000.00
Total	554		\$ 1000.00

As can be seen from Table 2-1, the total contract time for work under the Contract is **554** Calendar Days.

3. CONSTRUCTION SCHEDULE

- A.** 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 Owner, Engineer and Contractor in order to establish the final approved schedule as it relates to this Special Provision.

4. LIQUIDATED DAMAGES

- A.** For this project, the rates per calendar day for liquidated damages are as noted in Table 2-1 above.

5. CONTRACTOR'S WORK WEEK

- A.** The project's standard work week shall consist of five (5) days per week, ten (10) hours per day for the calendar days specified in Table 2-1. Weekend work requires prior approval by Airport Operations. Requests shall be made a minimum of 48 hours in advance of the proposed work weekend.

END OF SPECIAL PROVISION NO. 3

SPECIAL PROVISION NO. 4

PROTECTION OF AIRPORT CABLES, CONTROLS, NAVAIDS AND WEATHER BUREAU FACILITIES

1. NOTICE TO CONTRACTOR

The Contractor is hereby informed that there may be installed on the Airport FAA NAVAIDS including, without limitation, airfield lighting systems, electric cables and controls relating to such NAVAIDS and facilities. Such NAVAIDS and other facilities and electric cables must be fully protected during the entire construction time. Work under this contract can be accomplished in the vicinity of these facilities and cables only at approved periods of time.

Approval is subject to withdrawal at any time because of change in the weather, emergency conditions on the existing airfield areas, anticipation of emergency conditions, and for any other reason determined by the Resident Project Representative (RPR) acting under the orders and instructions of the airport management and the designated FAA representative. Any instructions to this Contractor to clear any given area at any time by the RPR or the Airport Management shall be immediately executed. Construction work will be commenced in the cleared area only when additional instructions are issued by the RPR.

2. POWER AND CONTROL CABLES

Power and control cables leading to and from any FAA NAVAIDS and other facilities have been located and shown from best available information and are approximate. The Contractor shall verify actual locations. Through the entire time of this construction, the Contractor shall not allow any construction equipment to cross power and control cables leading to and from any FAA NAVAIDS or other facilities without first protecting the cable with steel boiler plate, or similar structural devices, on three feet (3') either side of the marked cable route. All excavation within three feet (3') of existing cables shall be accomplished by hand digging only.

3. INTENT OF THIS SPECIAL PROVISION

This Special Provision intends to make perfectly clear the need for protection of FAA NAVAIDS and other facilities and cables by this Contractor at all times.

4. REPAIR BY CONTRACTOR

The Contractor shall immediately repair, at his own expense, with identical material by skilled workmen, any underground cables serving FAA NAVAIDS and other airport facilities, which are damaged by his workmen, equipment, or work. Prior approval of the FAA must be obtained for the materials, workmen, time of day or night, method of repairs, and for any temporary or permanent repairs the Contractor proposes to make to any FAA NAVAIDS and facilities damaged by the Contractor. Prior approval of the Engineer and RPR must be obtained for the materials, workmen, time of day or night, and for the method of repairs for any temporary or permanent repairs the Contractor proposes to make to any other airport facilities and cables damaged by this Contractor. Should the repair require splicing, it shall be spliced at the direction of the RPR. No work shall be backfilled or covered prior to approval by the RPR.

END OF SPECIAL PROVISION NO. 4

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TECHNICAL SPECIFICATIONS

ITEM P-100 - FDOT STANDARD SPECIFICATIONS

The construction details which will govern the prosecution of the work as set out in the project documents and/or shown on the project plans shall conform in their entirety to Divisions I, II and III of the Florida Department of Transportation Standard Specification for Road and Bridge Construction, Current Edition, including all FDOT Supplements and as modified hereinafter. The construction details contained in the Divisions which are not required to accomplish the work set out in the project documents and/or shown on the project plans will have no application to these specifications.

In the event of any conflict(s) between the Contract Documents and the FDOT Standard Specifications, the precedence in resolving such conflict(s) shall be as follows:

1. Bidding and Contract Requirements, and Technical Specifications for Parking Lot Addition and Exit lane Modifications – Punta Gorda Airport as located in this project documents shall govern over FDOT Bid and Contract Requirements.
2. Greater quantities shall govern over lesser.
3. Higher quality and/or more stringent requirements as adjudged by the Engineer shall govern over lessor.

Where FDOT Specifications refer to the "Engineer", "Engineer of Tests", or "Division of Tests", it shall be understood to mean the Engineer of the Owner as Stated in the CONTRACT.

These standard specifications can be obtained from the Florida Department of Transportation as follows:

Divisions I through XI, Standard Specifications for General Aviation Airports, Dated 1998 -

Manager-Aviation Office, MS46
Florida Department of Transportation
605 Suwannee Street
Tallahassee, Florida 32399-0450
(850) 414-4500
Fax (850) 922-4942

Divisions II and III of the Florida Department of Transportation Standard Specifications for Road and Bridge Construction, Current Edition -

Florida Department of Transportation
Map and Publication Sales, MS 12
605 Suwannee Street
Tallahassee, Florida 32399-0450
(850) 414-4050
Fax (850) 414-4915

A copy is on file and may be inspected at the Office of the Engineer.

The Contractor shall have at least one (1) set of the standard specifications available at the project site at all times during construction.

Specifications pertinent to this project from the Standard Specifications for Road and Bridge Construction are as follows:

<u>FDOT Section</u>	<u>Description</u>
100	Construction Equipment – General Requirements
102	Maintenance of Traffic
104	Prevention, Control, and Abatement of Erosion and Water Pollution
105	Contractor Quality Control General Requirements
110	Clearing and Grubbing
120	Excavation and Embankment
160	Stabilizing
285	Optional Base Course
320	Hot Bituminous Mixtures – Plant, Methods, and Equipment
330	Hot Bituminous Mixtures – General Construction Requirements
334	Superpave Asphalt Concrete
400	Concrete Structures
425	Inlets, Manholes, and Junction Boxes
430	Pipe Culverts
519	Concrete Bollards
520	Concrete Gutter, Curb Elements and Traffic Separator
522	Concrete Sidewalk
530	Revetment Systems
536	Guardrail
542	Bumper Guard, Concrete
700	Highway Signing
710	Painted Pavement Markings
981	Turf Materials

Specification sections not specified above but cross-referenced in the above individual sections are also included herewith and made a part of these Contract Documents.

Method of measurement and basis of payment for material and work performed in conformance with the above specifications shall be as indicated on the BID SCHEDULE and discussed below. The unit cost bid shall be full compensation for labor, equipment, materials and incidentals necessary to complete the work in conformance with the Plans and Specification to the satisfaction of the Owner. Incidentals include, but are not limited to, items that have specific FDOT bid item numbers in the referenced specifications but are not included in the Bid Schedule.

END OF SECTION P-100

DIVISION 02

SECTION 02 41 16 - SELECTIVE DEMOLITION FOR REMODELING

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes:
 - 1. All labor, materials, equipment, and supervision necessary to complete all selective demolition work including salvage, removal and disposal services required for remodeling, renovation, and addition work as indicated on Drawings.
- B. Related Sections include the following:
 - 1. Division 2 Section "Cutting and Patching" for cutting into existing construction and subsequent patching for remodeling work.

1.02 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- C. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.
- D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.03 QUALITY ASSURANCE

- A. Qualifications of Demolition Contractor:
 - 1. Demolition shall be performed only by a qualified Contractor with at least five (5) years documented experience in operations of a similar nature.
- B. Requirements of Regulatory Agencies:
 - 1. Comply with governing local and state safety codes pertaining to demolition work, and the following:
 - a. ANSI A10.6 Safety Requirements for Demolition Operations.
 - b. NFPA 241 Standard for Safeguarding Construction, Alteration, and Demolition Operations.
 - 2. Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

1.04 SUBMITTALS

- A. Schedule:

1. Submit schedule for any temporary disconnection of electrical, telephone, security, mechanical and/or plumbing service for Owner's approval. Such disconnections shall be restricted to outside of normal operating and/or business hours.

1.05 JOB CONDITIONS

A. Condition of Areas:

1. The Owner assumes no responsibility for actual condition of areas to be demolished.

B. Protection of Existing Construction:

1. Existing construction adjacent to demolition operations, and those portions designated to remain shall be given maximum protection while demolition work is in process. Damage to these portions shall be repaired or replaced at no additional cost to the Owner.

C. Salvage:

1. If indicated or otherwise required by the Owner, salvageable items shall include both existing items which shall be removed and relocated to new areas or re-used in existing locations as indicated on Drawings; and salvageable items which shall be turned over to the Owner for future maintenance. In both cases, salvageable items shall remain the property of the Owner and be carefully removed from the structure as work progresses. Items to be salvaged or re-used shall be determined by Architect/Engineer and/or Owner.
2. Items to be re-used shall be stored in a safe, secure area, and be protected from damage until they are re-installed per Drawings. Items which are to be turned over to the Owner for future maintenance shall be transported to an area designated by the Owner.
3. All salvageable items indicated on Drawings to be removed, which are not specifically scheduled for re-use, relocation, or future maintenance, shall become the property of the Contractor and shall be removed from the job site and premises.

D. Protection:

1. Ensure safe passage of persons around area of demolition. Conduct operations to prevent injury to adjacent structures, other facilities, and persons.
2. Erect temporary barriers and passageways as required.

E. Utility Services:

1. Existing utilities indicated to remain and to be kept in service, shall be maintained and protected against damage during demolition operations.
2. DO NOT interrupt existing utilities serving occupied or "in-use" facilities, except when authorized in writing by the Owner. Provide temporary services during interruptions to existing facilities, as acceptable to the Owner.

PART 2 - PRODUCTS

"Not Used"

PART 3 - EXECUTION

3.01 PREPARATION

- A. Posting of Danger Signs:
 - 1. Danger signs shall be conspicuously posted around demolition areas.
- B. Access to Demolition Area:
 - 1. With the exception of passageways and ladders for the use of workmen, access to demolition areas shall be entirely closed off at all times.
- C. Temporary Shoring:
 - 1. Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.
 - 2. Strengthen or add new supports when required during progress of demolition.

3.02 PROTECTION

- A. Protect existing work that is to remain in place, that is to be re-used, or that is to remain the property of the Owner, by temporary covers, shoring, bracing, and supports. Repair items damaged during performance of the work or replace with new. DO NOT overload structural elements. Provide new supports or reinforcement for existing construction weakened by demolition or removal work.

3.03 DEMOLITION

- A. Remove debris from elevated portions by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Remove structural framing members (if applicable) and lower to ground by method suitable to minimize ground impact or dust generation.
- C. Concrete: Cut concrete full depth at junctures with construction indicated to remain, using power-driven saw, then remove concrete between saw cuts.
- D. Masonry: Cut masonry at junctures with construction indicated to remain, using power-driven saw, then remove masonry between saw cuts.
- E. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished at junctures with construction indicated to remain, then break up and remove.
- F. Below-Grade Construction: Abandon foundation walls and other below-grade construction. Cut below-grade construction as indicated on Drawings.
- G. NO materials shall be dropped (by gravity) to any point.

3.04 FILLING VOIDS

- A. If required, foundations and all other items removed shall have resulting void completely filled as follows:
 - 1. Use satisfactory soil materials as defined in ASTM D 2487, consisting of stone, gravel,

and sand, free from debris and trash.

2. Prior to placement of fill materials, ensure that areas to be filled are free of standing water, trash and debris.
3. Place fill materials in horizontal layers not exceeding 6-inches in loose depth. Compact each layer at optimum moisture content of fill material to a density equal to original adjacent ground, but not less than 90 percent density when tested in accordance with ASTM D 1556, unless subsequent excavation for new work is required.
4. After fill placement and compaction, grade surface to meet adjacent contours.

3.05 DUST CONTROL

- A. Use temporary enclosures, and other suitable methods to limit dust and dirt rising and scattered in air to lowest practical level.
- B. Take appropriate action to check the spread of dust and to avoid the creation of a nuisance in the surrounding area. DO NOT use water.
- C. Comply with governing regulations pertaining to environmental protection.

3.05 DISPOSAL

- A. Except for all items to be salvaged, all parts of the structures and appurtenances and all materials recovered during their demolition shall become the property of the Contractor; shall be removed from the Project by the Contractor; and disposed of off-site in a legal manner.

3.06 CLEAN-UP

- A. Clean adjacent construction and improvements of dust, dirt, and debris caused by demolition operations, to a degree acceptable to the Architect/Engineer and the Owner. Return adjacent areas to condition existing prior to start of demolition work.
- B. Keep building areas including exterior clean and free of debris at all times.

END OF SECTION 02 41 16

SECTION 02 41 20 - CUTTING AND PATCHING

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes:
 - 1. Cutting, fitting and patching existing construction affected by and required to complete this Work to include, but not be limited to:
 - a. Make its several parts fit together properly.
 - b. Uncover portions of the work to provide for installation of ill-timed work.
 - c. Remove and replace defective work.
 - d. Remove and replace work not conforming to requirements of Contract Documents.
 - e. Provide penetrations of non-structural surfaces for installation of connections and electrical conduit.
- B. Related Sections include the following:
 - 1. Division 2 Section "Selective Demolition for Remodeling" for demolition work.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Comply with specifications and standards for each specific product(s) involved.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Inspect existing conditions of Project, including elements subject to damage or to movement during cutting and patching.
- B. After uncovering work, inspect conditions affecting installation of products, or performance of Work.
- C. Report unsatisfactory or questionable conditions to the Architect/Engineer. Do not proceed with work until the Architect/Engineer has provided further instructions.

3.02 PREPARATION

- A. Provide adequate temporary support as necessary to assure structural value to integrity of affected portion of the Work.

- B. Provide devices and methods to protect other portions of Project from damage.
- C. Provide protection from elements for that portion of the Project, which may be exposed by cutting and patching work.

3.03 PERFORMANCE

- A. Execute cutting and demolition by methods, which will prevent damage to other work and will provide proper surfaces to receive installation of repairs.
- B. Fit and adjust products to provide a finished installation to comply with specified products, functions, tolerances, and finishes.
- C. Restore work which has been cut or removed; install new products to provide completed work in accordance with the requirements of the Contract Documents.
- D. Replace surfaces airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- E. Refinish entire surfaces as necessary to provide an even finish to match adjacent finishes.

END OF SECTION 02 41 20

DIVISION 03

SECTION 03 10 00 - CONCRETE FORMING AND ACCESSORIES

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. Form-facing material for cast-in-place concrete.
 - 2. Form liners.
 - 3. Shoring, bracing, and anchoring.
- B. Related Requirements:
 - 1. Section 033000 "Cast-in-Place Concrete" for concrete work.

1.3 DEFINITIONS

- A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.
- B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction, movement, contraction, and isolation joints
 - c. Forms and form-removal limitations.
 - d. Shoring and reshoring procedures.
 - e. Anchor rod and anchorage device installation tolerances.

1.5 ACTION SUBMITTALS

- A. Product Data: For each of the following:
 - 1. Exposed surface form-facing material.
 - 2. Concealed surface form-facing material.
 - 3. Forms for cylindrical columns.

4. Pan-type forms.
5. Void forms.
6. Form liners.
7. Form ties.
8. Waterstops.
9. Form-release agent.

B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.

1. For exposed vertical concrete walls, indicate dimensions and form tie locations.
2. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301 (ACI 301M).
 - a. Location of construction joints is subject to approval of the Architect.
3. Indicate location of waterstops.
4. Indicate form liner layout and form line termination details.
5. Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.
6. Indicate layout of insulating concrete forms, dimensions, course heights, form types, and details.

C. Samples:

1. For waterstops.
2. For Form Liners: 12-inch by 12-inch sample, indicating texture.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing and inspection agency.
- B. Research Reports: For insulating concrete forms indicating compliance with International Code Council Acceptance Criteria AC308.
- C. Field quality-control reports.
- D. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

- A. Testing and Inspection Agency Qualifications: An independent agency, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
- B. Mockups: Formed surfaces to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship.
 1. If indicated on the project documents, build panel approximately 100 sq. ft. in the location indicated or, if not indicated, as directed by Architect.
 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Form Liners: Store form liners under cover to protect from sunlight.
- B. Insulating Concrete Forms: Store forms off ground and under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.
- C. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301 (ACI 301M), to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
 - 1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
 - 2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.
 - a. For architectural concrete specified in Section 033300 "Architectural Concrete," limit deflection of form-facing material, studs, and walers to 0.0025 times their respective clear spans (L/400).
- B. Design, engineer, erect, shore, brace, and maintain insulating concrete forms in accordance with ACI 301 (ACI 301M), to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
 - 1. Design cross ties to transfer the effects of the following loads to the cast-in-place concrete core:
 - a. Wind Loads: As indicated on Drawings.
 - 1) Horizontal Deflection Limit: Not more than 1/240 of the wall height.

2.2 FORM-FACING MATERIALS

- A. As-Cast Surface Form-Facing Material:
 - 1. Provide continuous, true, and smooth concrete surfaces.
 - 2. Furnish in largest practicable sizes to minimize number of joints.
 - 3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:
 - a. Plywood, metal, or other approved panel materials.
 - b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

- 1) APA HDO (high-density overlay).
 - 2) APA MDO (medium-density overlay); mill-release agent treated and edge sealed.
 - 3) APA Structural 1 Plyform, B-B or better; mill oiled and edge sealed.
 - 4) APA Plyform Class I, B-B or better; mill oiled and edge sealed.
- B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.
1. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces without spiral or vertical seams not exceeding specified formwork surface class.
1. Provide forms with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation, with straight or tapered end forms.
- E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- F. Form Liners: Face Pattern as indicated in the Project documents.

2.3 WATERSTOPS

- A. Flexible Rubber Waterstops: U.S. Army Corps of Engineers CRD-C 513, for embedding in concrete to prevent passage of fluids through joints, with factory fabricated corners, intersections, and directional changes.
1. Profile: As indicated.
 2. Dimensions: 4 inches by 3/16 inch thick minimum; nontapered.
- B. Chemically Resistant Flexible Waterstops: Thermoplastic elastomer rubber waterstops, for embedding in concrete to prevent passage of fluids through joints; resistant to oils, solvents, and chemicals, with factory fabricate corners, intersections, and directional changes.
1. Profile: As indicated.
 2. Dimensions: 4 inches by 3/16 inch thick minimum; nontapered.
- C. Flexible PVC Waterstops: U.S. Army Corps of Engineers CRD-C 572, for embedding in concrete to prevent passage of fluids through joints, with factory fabricate corners, intersections, and directional changes.
1. Profile: As indicated.
 2. Dimensions: 4 inches by 3/16 inch thick minimum; nontapered.
- D. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 inch by 1 inch.
- E. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer-modified chloroprene rubber, for adhesive bonding to concrete, 3/8 inch by 3/4 inch.

2.4 RELATED MATERIALS

- A. Reglets: Fabricate reglets of not less than 0.022-inch-thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- B. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 inch by 3/4 inch, minimum.
- D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- E. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
 - 2. Form release agent for form liners shall be acceptable to form liner manufacturer.
- F. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive damp-proofing or waterproofing.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

- A. Comply with ACI 301.
- B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes.
- C. Limit concrete surface irregularities as follows:
 - 1. Surface Finish-1.0: ACI 117 Class D, 1 inch.
 - 2. Surface Finish-2.0: ACI 117 Class B, 1/4 inch.
 - 3. Surface Finish-3.0: ACI 117 Class A, 1/8 inch.
- D. Construct forms tight enough to prevent loss of concrete mortar.
 - 1. Minimize joints.
 - 2. Exposed Concrete: Symmetrically align joints in forms.
- E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
 - 1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
 - 2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

3. Install keyways, reglets, recesses, and other accessories, for easy removal.
- F. Do not use rust-stained, steel, form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
1. Provide and secure units to support screed strips
 2. Use strike-off templates or compacting-type screeds.
- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.
1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
 2. Locate temporary openings in forms at inconspicuous locations.
- I. Chamfer exterior corners and edges of permanently exposed concrete.
- J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.
- K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
1. Determine sizes and locations from trades providing such items.
 2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.
- L. Construction and Movement Joints:
1. Construct joints true to line with faces perpendicular to surface plane of concrete.
 2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 3. Place joints perpendicular to main reinforcement.
 4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.
 - a. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 6. Space vertical joints in walls as indicated on Drawings.
 - a. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
 2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

- O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.
 - 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
 - 3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 4. Install dovetail anchor slots in concrete structures, as indicated on Drawings.
 - 5. Clean embedded items immediately prior to concrete placement.

3.3 INSTALLATION OF WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm.
 - 1. Install in longest lengths practicable.
 - 2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
 - 3. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete aggregate size specified in Section 033000 "Cast-In-Place Concrete."
 - 4. Secure waterstops in correct position at 12 inches on center.
 - 5. Field fabricate joints in accordance with manufacturer's instructions using heat welding.
 - a. Miter corners, intersections, and directional changes in waterstops.
 - b. Align center bulbs.
 - 6. Clean waterstops immediately prior to placement of concrete.
 - 7. Support and protect exposed waterstops during progress of the Work.
- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.
 - 1. Install in longest lengths practicable.
 - 2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
 - 3. Protect exposed waterstops during progress of the Work.

3.4 INSTALLATION OF INSULATING CONCRETE FORMS

- A. Comply with ACI 301 (ACI 301M) and manufacturer's instructions.

- B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 (ACI 117M).
- C. Install forms in running bond pattern.
 - 1. Align joints.
 - 2. Align furring strips.
- D. Construct forms tight to prevent loss of concrete mortar.
- E. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
 - 1. Determine sizes and locations from trades providing such items.
 - 2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.
- F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
 - 1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
 - 2. Close temporary ports and openings with tight fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- G. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- H. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- I. Shore insulating concrete forms to ensure stability and to resist stressing imposed by construction loads.

3.5 REMOVING AND REUSING FORMS

- A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
 - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work.
 - 1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
 - 2. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
 - 1. Align and secure joints to avoid offsets.
 - 2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.6 SHORING AND RESHORING INSTALLATION

- A. Comply with ACI 318 (ACI 318M) and ACI 301 (ACI 301M) for design, installation, and removal of shoring and reshoring.
 - 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.
- C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.7 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
 - 1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.
 - 2. Inspect insulating concrete forms for shape, location, and dimensions of the concrete member being formed.

END OF SECTION 03 10 00

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SECTION 03 20 00 - CONCRETE REINFORCING

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. Steel reinforcement bars.
 - 2. Welded-wire reinforcement.
- B. Related Requirements:
 - 1. Section 034100 "Precast Structural Concrete" for reinforcing used in precast structural concrete.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction contraction and isolation joints.
 - c. Steel-reinforcement installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Each type of steel reinforcement.
 - 2. Zinc repair material.
 - 3. Bar supports.
 - 4. Mechanical splice couplers.
- B. Shop Drawings: Comply with ACI SP-066:
 - 1. Include placing drawings that detail fabrication, bending, and placement.
 - 2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.
- C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.
 - 1. Location of construction joints is subject to approval of the Architect.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Statements: For testing and inspection agency, along with any delegated-design engineer which may be used.
- B. Delegated-Design Engineer Qualifications: Include the following:
 - 1. Experience providing delegated-design engineering services of the type indicated.
 - 2. Documentation that delegated-design engineer is licensed in the state in which Project is located.
- C. Welding certificates.
 - 1. Reinforcement to be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M
- D. Material Test Reports: For the following, from a qualified testing agency:
 - 1. Steel Reinforcement:
 - a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.
 - 2. Mechanical splice couplers. Provide documentation that couplers are capable of developing 125% of the bar yield strength.
- E. Field quality-control reports.
- F. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
- B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.
- C. Mockups: Reinforcing for cast-concrete formed surfaces, to demonstrate tolerances and standard of workmanship.
 - 1. If indicated in the project documents, build panel approximately 100 sq. ft. in the location indicated on Drawings or, if not indicated, as directed by Architect.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
 - 1. Store reinforcement to avoid contact with earth.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.
- B. Low-Alloy Steel Reinforcing Bars: ASTM A706/A706M, deformed.
- C. Headed-Steel Reinforcing Bars: ASTM A970/A970M.
- D. Steel Bar Mats: ASTM A184/A184M, fabricated from ASTM A615/A615M, Grade 60 or ASTM A706/A706M, deformed bars, assembled with clips.
- E. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.
- F. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

2.2 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
 - 1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
 - 2. Mechanical Splice Couplers: ACI 318 (ACI 318M), same material of reinforcing bar being spliced; capable of developing 125% of the bar yield strength.
- C. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.
 - 1. Finish: Plain.
- D. Stainless Steel Tie Wire: ASTM A1022/A1022M, not less than 0.0508 inch in diameter.

2.3 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protection of In-Place Conditions:
 - 1. Do not cut or puncture vapor retarder.
 - 2. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.
 - 1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
 - 2. Do not tack weld crossing reinforcing bars.
- C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 318 (ACI 318M).
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on the Drawings.
 - 1. Bar splices shall be staggered in accordance with ACI 318 (ACI 318M).
 - 2. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.
 - 3. Weld bars in accordance with AWS D1.4/D 1.4M, where indicated on Drawings.
- G. Install welded-wire reinforcement in longest practicable lengths.
 - 1. Support reinforcement in accordance with CRSI "Manual of Standard Practice."
 - a. For reinforcement less than W4.0 or D4.0, continuous support spacing shall not exceed 12 inches.
 - 2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
 - 3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
 - 4. Lace overlaps with wire.

3.3 JOINTS

- A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement.

2. Continue reinforcement across construction joints unless otherwise indicated.
 3. Do not continue reinforcement through sides of strip placements of floors and slabs.
- B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

3.4 INSTALLATION TOLERANCES

- A. Comply with ACI 117 (ACI 117M).

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
1. Steel-reinforcement placement, Steel-reinforcement mechanical splice couplers, and Steel-reinforcement welding.

END OF SECTION 03 20 00

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SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

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. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.
- B. Related Requirements:
 - 1. Section 031000 "Concrete Forming and Accessories" for form-facing materials, form liners, and waterstops.
 - 2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, and other pozzolans; materials subject to compliance with requirements.
- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete Subcontractor.
 - e. Special concrete finish Subcontractor.
 - 2. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction joints, control joints, isolation joints, and joint-filler strips.
 - c. Semirigid joint fillers.
 - d. Vapor-retarder installation.

- e. Anchor rod and anchorage device installation tolerances.
- f. Cold and hot weather concreting procedures.
- g. Concrete finishes and finishing.
- h. Curing procedures.
- i. Forms and form-removal limitations.
- j. Shoring and reshoring procedures.
- k. Methods for achieving specified floor and slab flatness and levelness.
- l. Floor and slab flatness and levelness measurements.
- m. Concrete repair procedures.
- n. Concrete protection.
- o. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
- p. Protection of field cured field test cylinders.

1.5 ACTION SUBMITTALS

A. Product Data: For each of the following.

- 1. Portland cement.
- 2. Fly ash.
- 3. Slag cement.
- 4. Blended hydraulic cement.
- 5. Performance-based hydraulic cement
- 6. Aggregates.
- 7. Admixtures:
 - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
- 8. Color pigments.
- 9. Fiber reinforcement.
- 10. Vapor retarders.
- 11. Floor and slab treatments.
- 12. Liquid floor treatments.
- 13. Curing materials.
 - a. Include documentation from color pigment manufacturer, indicating that proposed methods of curing are recommended by color pigment manufacturer.
- 14. Joint fillers.
- 15. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:

- 1. Mixture identification.
- 2. Minimum 28-day compressive strength.
- 3. Durability exposure class.
- 4. Maximum w/cm.
- 5. Slump limit.
- 6. Air content.
- 7. Nominal maximum aggregate size.
- 8. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.

9. Include manufacturer's certification that permeability-reducing admixture is compatible with mix design.
10. Include certification that dosage rate for permeability-reducing admixture matches dosage rate used in performance compliance test.
11. Intended placement method.
12. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Shop Drawings:

1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - a. Location of construction joints is subject to approval of the Architect.

D. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:

1. Concrete Class designation.
2. Location within Project.
3. Exposure Class designation.
4. Formed Surface Finish designation and final finish.
5. Final finish for floors.
6. Curing process.
7. Floor treatment if any.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

1. Installer: Include copies of applicable ACI certificates.
2. Ready-mixed concrete manufacturer.
3. Testing agency: Include copies of applicable ACI certificates.

B. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Curing compounds.
4. Floor and slab treatments.
5. Bonding agents.
6. Adhesives.
7. Vapor retarders.
8. Semirigid joint filler.
9. Joint-filler strips.
10. Repair materials.

C. Material Test Reports: For the following, from a qualified testing agency:

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Blended hydraulic cement.
5. Performance-based hydraulic cement.

6. Aggregates.
7. Admixtures:
 - a. Permeability-Reducing Admixture: Include independent test reports, indicating compliance with specified requirements, including dosage rate used in test.
- D. Floor surface flatness and levelness measurements report (if indicated on the drawings), indicating compliance with specified tolerances.
- E. Research Reports:
 1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
 2. For sheet vapor retarder/termite barrier, showing compliance with ICC AC380.
- F. Preconstruction Test Reports: For each mix design.
- G. Field quality-control reports.
- H. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician.
 1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.
- B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
 1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.
 1. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.
- D. Field Quality Control Testing Agency Qualifications: An independent agency, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
 1. Personnel conducting field tests shall be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.
- E. Mockups: If indicated in the Project documents, cast concrete formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship.
 1. Formed Surfaces: If indicated in the Project documents, build panel approximately 100 sq. ft. in the location indicated or, if not indicated, as directed by Architect.

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: If documentation on concrete mixtures are not available, engage a qualified testing agency to perform preconstruction testing on those concrete mixtures.
 1. Include the following information in each test report:
 - a. Admixture dosage rates.
 - b. Slump.
 - c. Air content.
 - d. Seven-day compressive strength.
 - e. 28-day compressive strength.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94/C94M and ACI 301 (ACI 301M).

1.10 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 306.1 and as follows.
 1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301 (ACI 301M).
 3. Do not use frozen materials or materials containing ice or snow.
 4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
 5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 305.1 (ACI 305.1M), and as follows:
 1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.11 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.
 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 (ACI 301M) unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
3. Obtain aggregate from single source.
4. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, either Type I, Type II, Type I/II, Type III, or Type V.
2. Fly Ash: ASTM C618, Class F only. Class C shall not be permitted.
3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
4. Blended Hydraulic Cement: ASTM C595/C595M; Type IS, portland blast-furnace slag; Type IP, portland-pozzolan; or Type IT, ternary blended (only with blends of Class F fly ash and slag) cement.
5. Silica Fume: The use of ASTM C1240 amorphous silica shall not be permitted.
6. Performance-Based Hydraulic Cement: ASTM C1157/C1157M: Type GU, general use; Type HE, high early strength; Type MS, moderate sulfate resistance; Type HS, high sulfate resistance; Type MH, moderate heat of hydration; or Type LH, low heat of hydration.

- C. Normal-Weight Aggregates: ASTM C33/C33M, coarse aggregate or better, graded. Provide aggregates from a single source.

1. Alkali-Silica Reaction: Comply with one of the following:

- a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.
- b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.
- c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. for moderately reactive aggregate or 3 lb./cu. yd. for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301 (ACI 301M).

2. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal.

3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C260/C260M.

- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride in concrete.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
7. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C494/C494M, Type C.
8. Non- Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
9. Permeability-Reducing Admixture: ASTM C494/C494M, Type S, hydrophilic, permeability-reducing crystalline admixture, capable of reducing water absorption of concrete exposed to hydrostatic pressure (PRAH).
 - a. Permeability: No leakage when tested in accordance with U.S. Army Corps of Engineers CRD C48 at a hydraulic pressure of 200 psi for 14 days.

- F. Water and Water Used to Make Ice: ASTM C94/C94M, potable, or complying with ASTM C1602/C1602M, including all limits listed in Table 2 and the requirements of paragraph 5.4.

2.3 VAPOR RETARDERS

- A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; and not less than 10 mils thick unless otherwise noted in the Drawings. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.4 FLOOR AND SLAB TREATMENTS

- A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.
- B. Slip-Resistive Aluminum Granule Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of not less than 95 percent fused aluminum-oxide granules.
- C. Emery Dry-Shake Floor Hardener: Unpigmented, factory-packaged, dry combination of portland cement, graded emery aggregate, and plasticizing admixture; with emery aggregate consisting of no less than 60 percent of total aggregate content.
- D. Metallic Dry-Shake Floor Hardener: Unpigmented, factory-packaged, dry combination of portland cement, graded metallic aggregate, rust inhibitors, and plasticizing admixture; with metallic aggregate consisting of no less than 65 percent of total aggregate content.
- E. Unpigmented Mineral Dry-Shake Floor Hardener: Factory-packaged dry combination of portland cement, graded quartz aggregate, and plasticizing admixture.

2.5 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

2.6 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
 - 1. Color:
 - a. Ambient Temperature Below 50 deg F: Black.
 - b. Ambient Temperature between 50 deg F and 85 deg F: Any color.
 - c. Ambient Temperature Above 85 deg F: White.
- D. Curing Paper: Eight-foot-wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.
- E. Water: Potable or complying with ASTM C1602/C1602M.
- F. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.
- G. Clear, Solvent-Borne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.
- H. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

2.7 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber, or ASTM D1752, cork or self-expanding cork.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, either epoxy resin with a Type A shore durometer hardness of 80, or aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 in accordance with ASTM D2240.
- C. Bonding Agent: ASTM C1059/C1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

- E. Floor Slab Protective Covering: Eight-feet-wide cellulose fabric.

2.8 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4000 psi at 28 days when tested in accordance with ASTM C109/C109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.

2.9 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301 (ACI 301M).
 - 1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash or Other Pozzolans: 25 percent by mass.
 - 2. Slag Cement: 50 percent by mass.
 - 3. Total of Fly Ash or Other Pozzolans, and Slag Cement: 50 percent by mass, with fly ash or other pozzolans not exceeding 25 percent by mass.
- C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
 - 1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete and concrete with a w/cm below 0.50.
 - 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
 - 5. Use permeability-reducing admixture in concrete mixtures where indicated.

- D. Color Pigment: If indicated in the drawings, add color pigment to concrete mixture in accordance with manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.10 CONCRETE MIXTURES

- A. Normal-weight concrete used for footings, foundation walls, grade beams, tie beams, building frame members, building walls, and exterior retaining walls.
 - 1. Exposure Class: ACI 318 (ACI 318M) F0, S1, W1, C1.
 - 2. Minimum Compressive Strength: As indicated on the drawings at 28 days.
 - 3. Maximum w/cm: 0.50.
 - 4. Air Content: Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete
- B. Normal-weight concrete used for interior slabs-on-ground.
 - 1. Exposure Class: ACI 318 (ACI 318M) F0, S1, W1, C1.
 - 2. Minimum Compressive Strength: As indicated on the drawings at 28 days.
 - 3. Maximum w/cm: As indicated in the 2020 Florida Building Code, Appendix E, Section E303.2.
 - 4. Slump: As indicated in the 2020 Florida Building Code, Appendix E, Section E303.2.
 - 5. Minimum Cementitious Materials Content: 520 lbs./cu. yd.
 - 6. Air Content: Do not allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
- C. Normal-weight concrete used for interior suspended slabs.
 - 1. Exposure Class: ACI 318 (ACI 318M) F0, S1, W1, C1.
 - 2. Minimum Compressive Strength: As indicated on the drawings at 28 days.
 - 3. Maximum w/cm: 0.45.
 - 4. Minimum Cementitious Materials Content: 520 lbs./cu. yd.
 - 5. Air Content: Do not allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
- D. Normal-weight concrete used for concrete toppings.
 - 1. Exposure Class: ACI 318 (ACI 318M) F0, S1, W1, C1.
 - 2. Minimum Compressive Strength: As indicated on the drawings at 28 days.
 - 3. Minimum Cementitious Materials Content: 520 lbs./cu. yd.
 - 4. Slump Limit: 4 inches.
 - 5. Air Content: Do not allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
- E. Normal-weight concrete used for interior metal pan stairs and landings:
 - 1. Exposure Class: ACI 318 (ACI 318M) F0, S1, W1, C1.
 - 2. Minimum Compressive Strength: 3000 psi at 28 days unless otherwise indicated on the drawings.
 - 3. Maximum w/cm: 0.50.
 - 4. Minimum Cementitious Materials Content: 470 lbs./cu. yd.
 - 5. Maximum Size Aggregate: 1/2 inch.
 - 6. Slump Limit: 3 inches, plus 1 inch or minus 2 inches.
 - 7. Air Content: Do not allow total air content to exceed 3 percent for concrete used in trowel-finished floors.

8. Retarding Admixture: Not allowed.
9. Accelerating Admixture: Not allowed.

2.11 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M, and furnish batch ticket information.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete in accordance with ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.
 1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
 1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
 2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
 1. Daily access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
 4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.

3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.4 INSTALLATION OF VAPOR RETARDER

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.
 1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
 2. Face laps away from exposed direction of concrete pour.
 3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
 4. Lap joints 6 inches and seal with manufacturer's recommended tape.
 5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
 6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
 7. Protect vapor retarder during placement of reinforcement and concrete.
 - a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.
- B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder in accordance with manufacturer's written instructions.

3.5 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
 1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
 2. Place joints perpendicular to main reinforcement.
 - a. Continue reinforcement across construction joints unless otherwise indicated.
 - b. Do not continue reinforcement through sides of strip placements of floors and slabs.
 3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 6. Space vertical joints in walls as indicated on Drawings. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
 7. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 8. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.
- D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on the Drawings.
 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints:
1. Install dowel bars and support assemblies at joints where indicated on the Drawings.
 2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.
- F. Dowel Plates: Install dowel plates at joints where indicated on the Drawings.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
 2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M), but not to exceed the amount indicated on the concrete delivery ticket.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
1. If a section cannot be placed continuously, provide construction joints as indicated.
 2. Deposit concrete to avoid segregation.

3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301 (ACI 301M).
 - a. Do not use vibrators to transport concrete inside forms.
 - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
 - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
 - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Do not place concrete floors and slabs in a checkerboard sequence.
 2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 3. Maintain reinforcement in position on chairs during concrete placement.
 4. Screed slab surfaces with a straightedge and strike off to correct elevations.
 5. Level concrete, cut high areas, and fill low areas.
 6. Slope surfaces uniformly to drains where required.
 7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
 8. Do not further disturb slab surfaces before starting finishing operations.

3.7 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 (ACI 301M) Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
 - a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
 - b. Remove projections larger than 1 inch.
 - c. Tie holes do not require patching.
 - d. Surface Tolerance: ACI 117 (ACI 117M) Class D.
 - e. Apply to concrete surfaces not exposed to public view.
2. ACI 301 (ACI 301M) Surface Finish SF-3.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
 - a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
 - b. Remove projections larger than 1/4 inch.
 - c. Patch tie holes.
 - d. Surface Tolerance: ACI 117 (ACI 117M) Class B.
 - e. Locations: Apply to concrete surfaces exposed to public view, or to be covered with a coating or covering material applied directly to concrete.

B. Rubbed Finish: Apply the following to as cast surface finishes where indicated on Drawings:

1. Smooth-Rubbed Finish:

- a. Perform no later than one day after form removal.
 - b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
 - c. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the in-place concrete.
 - d. Maintain required patterns or variances as shown on the Drawings or to match mockups.
2. Grout-Cleaned Rubbed Finish:
- a. Clean concrete surfaces after contiguous surfaces are completed and accessible.
 - b. Do not clean concrete surfaces as Work progresses.
 - c. Mix 1 part portland cement to 1-1/2 parts fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.
 - d. Wet concrete surfaces.
 - e. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap, and keep surface damp by fog spray for at least 36 hours.
 - f. Maintain required patterns or variances as shown on Drawings or to match mockups.
3. Cork-Floated Finish:
- a. Mix 1 part portland cement to 1 part fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint.
 - b. Mix 1 part portland cement and 1 part fine sand with sufficient water to produce a mixture of stiff grout. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.
 - c. Wet concrete surfaces.
 - d. Compress grout into voids by grinding surface.
 - e. In a swirling motion, finish surface with a cork float.
 - f. Maintain required patterns or variances as shown on Drawings or to match mockups.
4. Scrubbed Finish: After concrete has achieved a compressive strength of from 1000 to 1500 psi, apply scrubbed finish.
- a. Wet concrete surfaces thoroughly and scrub with stiff fiber or wire brushes, using water freely, until top mortar surface is removed and aggregate is uniformly exposed.
 - b. Rinse scrubbed surfaces with clean water.
 - c. Maintain continuity of finish on each surface or area of Work.
 - d. Remove only enough concrete mortar from surfaces to match mockups.
- C. Abrasive-Blast Finish: Apply the following to as-cast surface finishes where indicated on Drawings:
- 1. Perform abrasive blasting after compressive strength of concrete exceeds 2000 psi.
 - 2. Coordinate with formwork removal to ensure that surfaces to be abrasive blasted are treated at the same age.
 - 3. Surface Continuity:
 - a. Perform abrasive-blast finishing as continuous operation, maintaining continuity of finish on each surface or area of Work.
 - b. Maintain required patterns or variances in depths of blast to match mockups.
 - 4. Abrasive Blasting:

- a. Abrasive-blast corners and edges of patterns carefully, using backup boards to maintain uniform corner and edge lines.
 - b. Determine type of nozzle pressure and blasting techniques required to match field sample.
 - c. Depth of Cut: Use an abrasive grit of proper type and gradation to expose aggregate and surrounding matrix surfaces to match field sample, as follows:
 - 1) Brush Texture: Remove cement matrix to dull surface sheen and expose face of fine aggregate, with no significant reveal.
 - 2) Light Texture: Expose fine aggregate with occasional exposure of coarse aggregate and uniform color, with maximum reveal of 1/16 inch.
 - 3) Medium Texture: Generally, expose coarse aggregate with slight reveal and with a maximum reveal of 1/4 inch.
 - 4) Heavy Texture: Expose and reveal coarse aggregate to a maximum projection of one-third its diameter, with reveal range of 1/4 to 1/2 inch.
 - d. Maintain required patterns or variances in reveal projection to match mockups.
- D. High-Pressure Water-Jet Finish: Apply the following to as-cast surface finishes where indicated on Drawings:
- 1. Perform high-pressure water jetting on concrete that has achieved a minimum compressive strength of 4500 psi.
 - 2. Coordinate with formwork removal to ensure that surfaces to be high-pressure water-jet finished are treated at same age for uniform results.
 - 3. Surface Continuity: Perform high-pressure water-jet finishing in as continuous an operation as possible, maintaining continuity of finish on each surface or area of Work.
 - 4. Maintain required patterns or variances in reveal projection to match mockups.
- E. Bushhammer Finish: Apply the following to as-cast surface finishes where indicated on Drawings:
- 1. Perform bushhammer finish to concrete that has achieved a minimum compressive strength of 4500 psi.
 - 2. Surface Continuity:
 - a. Perform bushhammer finishing in as continuous an operation as possible, maintaining continuity of finish on each surface or area of Work.
 - 3. Surface Cut:
 - a. Maintain required depth of cut and general aggregate exposure.
 - b. Use power tool with hammer attachments for large, flat surfaces, and use hand hammers for small areas, at corners and edges, and for restricted locations where power tools cannot reach.
 - 4. Remove impressions of formwork and form facings with exception of tie holes.
 - 5. Maintain required patterns or variances of cut as shown on Drawings or to match mockups.
 - 6. Maintain control of concrete chips, dust, and debris in each Work area, limiting migration of airborne materials and dust by use of tarpaulins, wind-breaks, or similar devices.
- F. Related Unformed Surfaces:
- 1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
 - 2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

- A. Comply with ACI 302.1R recommendations for screeding, re-straightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish:
 - 1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
 - 2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch in one direction.
 - 3. Apply scratch finish to surfaces to receive concrete floor toppings, or to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish:
 - 1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
 - 2. Repeat float passes and re-straightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 (ACI 117M) tolerances for conventional concrete.
 - 3. Apply float finish to surfaces to receive trowel finish, and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- D. Trowel Finish:
 - 1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
 - 2. Continue troweling passes and re-straighten until surface is free of trowel marks and uniform in texture and appearance.
 - 3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 4. Do not add water to concrete surface.
 - 5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
 - 6. Apply a trowel finish to surfaces exposed to view, or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 - 7. Finish surfaces to the following tolerances, in accordance with ASTM E1155 (ASTM E1155M), for a randomly trafficked floor surface:
 - a. Slabs on Ground:
 - 1) Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.-long straightedge resting on two high spots and placed anywhere on the surface does not exceed 3/16 inch in 2 feet.
 - b. Suspended Slabs:
 - 1) Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.-long straightedge resting on two high spots and placed anywhere on the surface does not exceed 3/16 inch in 2 feet.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated on the Drawings. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.
 - 1. Coordinate required final finish with Architect before application.
 - 2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
 - 2. Coordinate required final finish with Architect before application.
- G. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate finish to concrete stair treads, platforms, ramps as indicated on Drawings
 - 1. Apply in accordance with manufacturer's written instructions and as follows:
 - a. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aggregate over surface in one or two applications.
 - b. Tamp aggregate flush with surface, but do not force below surface.
 - c. After broadcasting and tamping, apply float finish.
 - d. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate.
- H. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces in accordance with manufacturer's written instructions and as follows:
 - 1. Uniformly apply dry-shake floor hardener at a rate of 100 lb/100 sq. ft. unless greater amount is recommended by manufacturer.
 - 2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader and embed by power floating.
 - 3. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.
 - 4. After final floating, apply a trowel finish.
 - 5. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

3.9 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

- A. Filling In:
 - 1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
 - 2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
 - 3. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
 - 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 - 2. Construct concrete bases 6 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
 - 3. Minimum Compressive Strength: 3000 psi at 28 days.
 - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 12-inch centers around the full perimeter of concrete base.

5. For supported equipment, install galvanized anchor bolts that extend through concrete base and anchor into structural concrete substrate.
 6. Prior to pouring concrete, place and secure anchorage devices.
 - a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - b. Cast anchor-bolt insert into bases.
 - c. Install anchor bolts to elevations required for proper attachment to supported equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.
1. Cast-in inserts and accessories, as shown on Drawings.
 2. Screed, tamp, and trowel finish concrete surfaces.

3.10 CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
1. Comply with ACI 301 (ACI 301M) and ACI 306.1 for cold weather protection during curing.
 2. Comply with ACI 301 (ACI 301M) and ACI 305.1 (ACI 305.1M) for hot-weather protection during curing.
 3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h , as calculated in accordance with ACI 305.1, before and during finishing operations.
- B. Curing Formed Surfaces: Comply with ACI 308.1 (ACI 308.1M) as follows:
1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
 2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
 3. If forms remain during curing period, moist cure after loosening forms.
 4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
 - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
 - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
 - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
 - d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
 - e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - 1) Recoat areas subject to heavy rainfall within three hours after initial application.
 - 2) Maintain continuity of coating and repair damage during curing period.
- C. Curing Unformed Surfaces: Comply with ACI 308.1 (ACI 308.1M) as follows:
1. Begin curing immediately after finishing concrete.
 2. Interior Concrete Floors:
 - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:

- 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12-inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
 - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
- b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:
- 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
 - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
- c. Floors to Receive Polished Finish: Contractor has option of the following:
- 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

- a) Lap edges and ends of absorptive cover not less than 12 inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
- 2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
- d. Floors to Receive Chemical Stain:
 - 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install curing paper over entire area of floor.
 - 2) Install curing paper square to building lines, without wrinkles, and in a single length without end joints.
 - 3) Butt sides of curing paper tight; do not overlap sides of curing paper.
 - 4) Leave curing paper in place for duration of curing period, but not less than 28 days.
- e. Floors to Receive Urethane Flooring:
 - 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - 2) Rewet absorptive cover, and cover immediately with polyethylene moisture-retaining cover with edges lapped 6 inches and sealed in place.
 - 3) Secure polyethylene moisture-retaining cover in place to prohibit air from circulating under polyethylene moisture-retaining cover.
 - 4) Leave absorptive cover and polyethylene moisture-retaining cover in place for duration of curing period, but not less than 28 days.
- f. Floors to Receive Curing Compound:
 - 1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
 - 3) Maintain continuity of coating, and repair damage during curing period.
 - 4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.
- g. Floors to Receive Curing and Sealing Compound:
 - 1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
 - 3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.11 TOLERANCES

- A. Conform to ACI 117 (ACI 117M).

3.12 APPLICATION OF LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.
 - 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 - 2. Do not apply to concrete that is less than four days old.
 - 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
 - 4. Rinse with water; remove excess material until surface is dry.
 - 5. Apply a second coat in a similar manner if surface is rough or porous.
- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller in accordance with manufacturer's written instructions.

3.13 JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least 28 days.
 - 2. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.14 CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
 - 1. Repair and patch defective areas when approved by Architect.
 - 2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.
 - a. Limit cut depth to 3/4 inch.
 - b. Make edges of cuts perpendicular to concrete surface.
 - c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
 - d. Fill and compact with patching mortar before bonding agent has dried.
 - e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
 - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
 - b. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
 - a. Correct low and high areas.
 - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
 - a. Finish repaired areas to blend into adjacent concrete.
5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
 - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - b. Feather edges to match adjacent floor elevations.
6. Correct other low areas scheduled to remain exposed with repair topping.
 - a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
 - b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
 - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
 - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
 - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
 - d. Place, compact, and finish to blend with adjacent finished concrete.
 - e. Cure in same manner as adjacent concrete.
8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
 - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.

- b. Dampen cleaned concrete surfaces and apply bonding agent.
 - c. Place patching mortar before bonding agent has dried.
 - d. Compact patching mortar and finish to match adjacent concrete.
 - e. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.15 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
 - 1. Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
 - 2. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
 - 3. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
 - a. Test reports shall include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
 - 1) Project name.
 - 2) Name of testing agency.
 - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
 - 4) Name of concrete manufacturer.
 - 5) Date and time of inspection, sampling, and field testing.
 - 6) Date and time of concrete placement.
 - 7) Location in Work of concrete represented by samples.
 - 8) Date and time sample was obtained.
 - 9) Truck and batch ticket numbers.
 - 10) Design compressive strength at 28 days.
 - 11) Concrete mixture designation, proportions, and materials.
 - 12) Field test results.
 - 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
 - 14) Type of fracture and compressive break strengths at seven days and 28 days.
- C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- D. Inspections:
 - 1. Headed bolts and studs.
 - 2. Verification of use of required design mixture.
 - 3. Concrete placement, including conveying and depositing.

4. Curing procedures and maintenance of curing temperature.
 5. Verification of concrete strength before removal of shores and forms from beams and slabs.
 6. Batch Plant Inspections: On a random basis, as determined by Architect.
- E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall be performed in accordance with the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C143/C143M:
 - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - b. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete.
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C1064/C1064M:
 - a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
 5. Unit Weight: ASTM C567/C567M fresh unit weight of structural lightweight concrete.
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 6. Compression Test Specimens: ASTM C31/C31M:
 - a. Cast and laboratory cure one set of five 6-inch by 12-inch cylinder specimens for each composite sample.
 7. Compressive-Strength Tests: ASTM C39/C39M.
 - a. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days. Keep the fifth specimen in reserve for additional testing. The additional testing may be requested by the Architect.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below the specified compressive strength by more than 500 psi for

specified compressive strengths up to 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.

10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

11. Additional Tests:

- a. Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.

- 1) Acceptance criteria for concrete strength shall be in accordance with ACI 301 (ACI 301M), section 1.6.6.3.

12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

- F. Measure floor and slab flatness and levelness in accordance with ASTM E1155 (ASTM E1155M) within 48 hours of completion of floor finishing and promptly report test results to Architect.

3.16 PROTECTION

- A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.
7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION 03 30 00

DIVISION 04

DIVISION 04

SECTION 04 22 00 - CONCRETE UNIT MASONRY

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. Concrete masonry units.
 - 2. Mortar and grout.
 - 3. Steel reinforcing bars.
 - 4. Masonry-joint reinforcement.
 - 5. Embedded flashing.
 - 6. Miscellaneous masonry accessories.
 - 7. Masonry-cell fill.
- B. Related Requirements:
 - 1. Section 031000 "Concrete Forms and Accessories" for dovetail slots for masonry anchors.
 - 2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and reinforcement accessories.
 - 3. Section 033000 "Cast-in-Place Concrete" for grout and mortar materials.

1.3 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For the following:
 - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
 - 2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.
 - 3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Initial Selection:

1. Decorative CMUs, in the form of small-scale units.
2. Pre-faced CMUs.
3. Colored mortar.
4. Weep holes/vents.

D. Samples for Verification: For each type and color of the following:

1. CMUs.
2. Pre-faced CMUs.
3. Mortar. Make Samples using same sand and mortar ingredients to be used on Project.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Material Certificates: For each type and size of the following:

1. Masonry units.
 - a. Include material test reports substantiating compliance with requirements.
 - b. For masonry units, include data and calculations establishing average net-area compressive strength of units.
2. Integral water repellant used in CMUs.
3. Cementitious materials. Include name of manufacturer, brand name, and type.
4. Mortar admixtures.
5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
6. Grout mixes. Include description of type and proportions of ingredients.
7. Reinforcing bars.
8. Joint reinforcement.
9. Anchors, ties, and metal accessories.

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
2. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.

D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.

E. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C1093 for testing indicated.
- B. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.
 - 1. Build sample panels for typical exterior and interior walls in sizes approximately 48 inches long by 48 inches high by full thickness.
 - 2. Build sample panels facing south.
 - 3. Where masonry is to match existing, build panels adjacent and parallel to existing surface.
 - 4. Protect approved sample panels from the elements with weather-resistant membrane.
 - 5. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.
 - a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless Architect specifically approves such deviations in writing.
- C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - 2. Build mockups for typical exterior and interior walls in sizes approximately 48 inches long by 48 inches high by full thickness, including face and backup wythes and accessories.
 - a. Include a sealant-filled joint at least 16 inches long in at least one exterior wall mockup.
 - b. Include lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately 12 inches wide by 16 inches high.
 - c. Include through-wall flashing installed for a 24-inch length in corner of exterior wall mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).
 - 3. Protect accepted mockups from the elements with weather-resistant membrane.
 - 4. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
 - a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
 - b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.9 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

- A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.
 - 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.
 - 2. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C1314.

2.3 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
 - 1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.4 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 - 2. Provide square-edged units for outside corners unless otherwise indicated.
- B. Integral Water Repellent: Provide units made with integral water repellent for exposed units and where indicated.
 - 1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E514/E514M as a wall assembly made with mortar containing integral water-repellent

manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.

- C. Insulated CMUs: Where indicated, units shall contain rigid, specially shaped, molded-polystyrene insulation units complying with ASTM C578, Type I, designed for installing in cores of masonry units.
- D. CMUs: ASTM C90.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength as indicated on the Drawings.
 - 2. Density Classification: Normal weight.
 - 3. Size (Width): Manufactured to dimensions 3/8 inch less-than-nominal dimensions.
 - 4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.
 - 5. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.

2.5 CONCRETE AND MASONRY LINTELS

- A. General: Provide one of the following:
- B. Concrete Lintels: ASTM C1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than that of CMUs.
- C. Concrete Lintels: Precast or formed-in-place concrete lintels complying with requirements in Section 032000 "Concrete Reinforcing," and with reinforcing bars indicated.
- D. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.6 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I, Type II, and Type I/II; except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
 - 1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C114.
- B. Hydrated Lime: ASTM C207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Masonry Cement: ASTM C91/C91M.
- E. Mortar Cement: ASTM C1329/C1329M.
- F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.

- G. Colored Cement Products: Packaged blend made from portland cement and hydrated lime, or masonry cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.
 - 1. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
 - 2. Pigments shall not exceed 10 percent of portland cement by weight.
 - 3. Pigments shall not exceed 5 percent of masonry cement by weight.
- H. Aggregate for Mortar: ASTM C144.
 - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand.
 - 2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
 - 3. White-Mortar Aggregates: Natural white sand.
 - 4. Colored-Mortar Aggregates: Natural sand of color necessary to produce required mortar color.
- I. Aggregate for Grout: ASTM C404.
- J. Epoxy Pointing Mortar: ASTM C395, epoxy-resin-based material formulated for use as pointing mortar for glazed or pre-faced masonry units (and approved for such use by manufacturer of units); in color indicated or, if not otherwise indicated, as selected by Architect from manufacturer's colors.
- K. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
- L. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.
- M. Water: Potable.

2.7 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60.
- B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
- C. Masonry-Joint Reinforcement, General: Ladder type complying with ASTM A951/A951M.
 - 1. Interior Walls: Hot-dip galvanized carbon steel.
 - 2. Exterior Walls: Hot-dip galvanized carbon steel.
 - 3. Wire Size for Side Rods: 0.148-inch diameter unless a larger diameter wire size is indicated on the Drawings.
 - 4. Wire Size for Cross Rods: 0.148-inch diameter unless a larger diameter wire size is indicated on the Drawings.
 - 5. Spacing of Cross Rods: Not more than 16 inches o.c., unless an 8 inch spacing is indicated on the Drawings.
 - 6. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

2.8 TIES AND ANCHORS

- A. General: Ties and anchors shall extend at least 1-1/2 inches into masonry but with at least a 5/8-inch cover on outside face.
- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
 - 1. Mill-Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A641/A641M, Class 1 coating.
 - 2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A153/A153M, Class B-2 coating.
 - 3. Stainless Steel Wire: ASTM A580/A580M, Type 304.
 - 4. Galvanized-Steel Sheet: ASTM A653/A653M, Commercial Steel, G60 zinc coating.
 - 5. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
 - 6. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.
 - 7. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
 - 1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch-diameter, hot-dip galvanized steel wire; unless a larger diameter wire size is indicated on the Drawings.
 - 2. Tie Section: Triangular-shaped wire tie made from 0.187-inch-diameter, hot-dip galvanized steel wire; unless a larger diameter wire size is indicated on the Drawings.
- D. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
 - 1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.060-inch-thick steel sheet, galvanized after fabrication.
 - a. 0.064-inch-thick, galvanized-steel sheet may be used at interior walls unless otherwise indicated.
 - 2. Tie Section: Triangular-shaped wire tie made from 0.187-inch-diameter, hot-dip galvanized steel wire; unless a larger diameter wire size is indicated on the Drawings.
 - 3. Corrugated-Metal Ties: Metal strips not less than 7/8 inch wide with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch made from 0.060-inch-thick steel sheet, galvanized after fabrication with dovetail tabs for inserting into dovetail slots in concrete.
 - a. 0.064-inch-thick, galvanized sheet may be used at interior walls unless otherwise indicated.
- E. Partition Top Anchors: 0.105-inch-thick metal plate with a 3/8-inch-diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.
- F. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.
 - 1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A153/A153M.

2.9 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.016 inch thick.
 2. Copper: ASTM B370, Temper H00, cold-rolled copper sheet, 16-oz./sq. ft. weight or 0.0216 inch thick or ASTM B370, Temper H01, high-yield copper sheet, 12-oz./sq. ft. weight or 0.0162 inch thick.
 3. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
 4. Fabricate through-wall metal flashing embedded in masonry as indicated.
 5. Fabricate metal drip edges and sealant stops as indicated. Form hem on upper surface of metal so that completed seam sheds water.
 6. Fabricate metal drip edges from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
 7. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
 8. Fabricate metal expansion-joint strips from material indicated to shapes indicated.
 9. Solder metal items at corners.
- B. Flexible Flashing: Use one of the following unless otherwise indicated:
1. Copper-Laminated Flashing: 5-oz./sq. ft. (unless otherwise indicated) copper sheet bonded between two layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry
 2. Asphalt-Coated Copper Flashing: 5-oz./sq. ft. (unless otherwise indicated) copper sheet coated with flexible asphalt. Use only where flashing is fully concealed in masonry.
 3. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.030 inch.
 - a. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
 4. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.030 inch (unless otherwise indicated).
 - a. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
 5. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy.
 - a. Monolithic Sheet: Elastomeric thermoplastic flashing, 0.040-inch-thick.
 - b. Self-Adhesive Sheet with Drip Edge: Elastomeric thermoplastic flashing, 0.025-inch-thick, with a 0.015-inch-thick coating of rubberized-asphalt adhesive. Where flashing extends to face of masonry, rubberized-asphalt coating is held back approximately 1-1/2 inches from edge.
 - 1) Color: As indicated.

- c. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
- 6. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D4637/D4637M, 0.040-inch-thick.
- C. Application: Unless otherwise indicated, use the following:
 - 1. Where flashing is indicated to receive counterflashing, use metal flashing.
 - 2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
 - 3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge (unless otherwise indicated).
 - 4. Where flashing is fully concealed, use metal flashing.
- D. Single-Wythe CMU Flashing System: System of CMU cell flashing pans and interlocking CMU web covers made from UV-resistant, high-density polyethylene. Cell flashing pans have integral weep spouts designed to be built into mortar bed joints and that extend into the cell to prevent clogging with mortar.
- E. Solder and Sealants for Sheet Metal Flashings:
 - 1. Solder for Stainless Steel: ASTM B32, Grade Sn60 or Grade Sn96, with acid flux of type recommended by stainless steel sheet manufacturer.
 - 2. Solder for Copper: ASTM B32, Grade Sn50 with maximum lead content of 0.2 percent.
 - 3. Elastomeric Sealant: ASTM C920, chemically curing urethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and remain watertight.
- F. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 or PVC, complying with ASTM D2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

2.11 MASONRY-CELL FILL

- A. Loose-Fill Insulation: Perlite complying with ASTM C549, Type II (surface treated for water repellency and limited moisture absorption) or Type IV (surface treated for water repellency and to limit dust generation).
- B. Lightweight-Aggregate Fill: ASTM C331/C331M.

2.12 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. Use portland cement-lime or masonry cement mortar unless otherwise indicated.
 - 3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated on the Drawings.
 - 1. For masonry below grade or in contact with earth, use Type M.
 - 2. For reinforced masonry, use Type S (unless otherwise indicated).
 - 3. For mortar parge coats, use Type S or Type N.
 - 4. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type S (unless otherwise indicated).
 - 5. For interior nonload-bearing partitions, Type N may be used instead of Type S (unless otherwise indicated).
- D. Pigmented Mortar: If the use of a pigmented mortar is indicated, provide a colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.
 - 1. Pigments shall not exceed 10 percent of portland cement by weight.
 - 2. Pigments shall not exceed 5 percent of masonry cement by weight.
 - 3. Mix to match Architect's sample.
 - 4. Application: Use pigmented mortar for exposed mortar joints at locations indicated.
- E. Colored-Aggregate Mortar: If the use of a color-aggregate mortar is indicated, produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
 - 1. Mix to match Architect's sample.
 - 2. Application: Use colored-aggregate mortar for exposed mortar joints at locations indicated.
- F. Grout for Unit Masonry: Comply with ASTM C476.
 - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
 - 2. Use grout in accordance with ASTM C476. Provide the minimum grout strength indicated on the Drawings, but not less than a 28-day compressive strength of 2000 psi, as tested in accordance with ASTM C1019.
 - 3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C143/C143M.
- G. Epoxy Pointing Mortar: Mix epoxy pointing mortar to comply with mortar manufacturer's written instructions.
 - 1. Application: Use epoxy pointing mortar for exposed mortar joints with pre-faced CMUs.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
 - 2. Verify that foundations are within tolerances specified.
 - 3. Verify that reinforcing dowels are properly placed.
 - 4. Verify that substrates are free of substances that would impair mortar bond.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Build chases and recesses to accommodate items specified in this and other Sections.
- B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
- C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.3 TOLERANCES

- A. Dimensions and Locations of Elements:
 - 1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
 - 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
 - 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.
- B. Lines and Levels:
 - 1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
 - 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10, 1/4 inch in 20 feet, or 1/2-inch maximum.
 - 3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
 - 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.

5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond (unless otherwise indicated); do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
- H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- I. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
 1. Install compressible filler in joint between top of partition and underside of structure above.
 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch

clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.

3. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 "Joint Firestopping."

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

B. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.

1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
2. Wet joint surfaces thoroughly before applying mortar.
3. Rake out mortar joints for pointing with sealant.

D. Rake out mortar joints at pre-faced CMUs to a uniform depth of 1/4 inch and point with epoxy mortar to comply with epoxy-mortar manufacturer's written instructions.

E. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

F. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

G. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

3.6 MASONRY-CELL FILL

A. Pour loose-fill insulation into cavities to fill void spaces. Maintain inspection ports to show presence of fill at extremities of each pour area. Close the ports after filling has been confirmed. Limit the fall of fill to one story high, but not more than 20 feet.

B. Install molded-polystyrene insulation units into masonry unit cells before laying units.

3.7 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.

2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to all continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
 - C. Provide continuity at wall intersections by using prefabricated T-shaped units.
 - D. Provide continuity at corners by using prefabricated L-shaped units.
 - E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.8 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:
 1. Provide an open space not less than 1/2 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
 3. Space anchors as indicated, but not more than 16 inches o.c. vertically and 24 inches o.c. horizontally.

3.9 CONTROL AND EXPANSION JOINTS

- A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry using one of the following methods:
 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
 2. Install preformed control-joint gaskets designed to fit standard sash block.
 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.
 4. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.

3.10 LINTELS

- A. Provide concrete lintels where shown and where openings of more than 4 inches for brick-size units and 12 inches for block-size units are shown without structural steel or other supporting lintels.
- B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.11 FLASHING

- A. General: Install embedded flashing at ledges and other obstructions to downward flow of water in wall where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At lintels, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
3. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
4. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
5. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
6. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
7. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

3.12 REINFORCED UNIT MASONRY

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches.

3.13 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections.

Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

- B. Inspections: Special inspections according to TMS 402/ACI 530/ASCE 5.
 - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
 - 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
 - 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- D. Testing Prior to Construction: One set of tests.
- E. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- F. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140 for compressive strength.
- G. Mortar Test (Property Specification): For each mix provided, according to ASTM C780. Test mortar for compressive strength.
- H. Grout Test (Compressive Strength): For each mix provided and for each day of grout placement, in accordance with ASTM C1019.
- I. Prism Test: If indicated on the drawings, provide prism testing in accordance with ASTM C1314 at 28 days.

3.14 PARGING

- A. Parge exterior faces of below-grade masonry walls, where indicated, in two uniform coats to a total thickness of 3/4 inch. Dampen wall before applying first coat, and scarify first coat to ensure full bond to subsequent coat.
- B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot. Form a wash at top of parging and a cove at bottom.
- C. Damp-cure parging for at least 24 hours and protect parging until cured.

3.15 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

3.16 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Waste Disposal: Dispose of masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units.
1. Crush masonry waste to less than 4 inches in each dimension.
 2. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- C. Masonry Waste Recycling: Return broken CMUs to manufacturer for recycling.
- D. Masonry Waste: Remove masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 22 00

DIVISION 05

SECTION 05 12 00 - STRUCTURAL STEEL 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. Structural steel.
- 2. Shear stud connectors.
- 3. Shrinkage-resistant grout.

- B. Related Requirements:

- 1. Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.
- 2. Section 055000 "Metal Fabrications" for miscellaneous steel fabrications and other steel items not defined as structural steel.
- 3. Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" and Section 099600 "High-Performance Coatings" for painting requirements.

1.3 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.4 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

- A. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Shear stud connectors.
4. Anchor rods.
5. Threaded rods.
6. Forged-steel hardware.
7. Shop primer.
8. Galvanized-steel primer.
9. Etching cleaner.
10. Galvanized repair paint.
11. Shrinkage-resistant grout.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Identify members not to be shop primed.

C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide in accordance with AWS D1.1/D1.1M for each welded joint whether prequalified or qualified by testing, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand-critical welds.

D. Delegated-Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include calculations and analysis data signed and sealed by the qualified professional engineer, licensed in the State of Florida, responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, fabricator, shop-painting applicators, professional engineer, and testing agency.
- B. Welding certificates. Welding operator's qualification certificates more than 12 months old, must be accompanied by documentation that a welder has been engaged in relevant welding since the date of certification.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill test reports for structural-steel materials, including chemical and physical properties.
- E. Product Test Reports: For the following:
 1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
 2. Direct-tension indicators.
 3. Tension-control, high-strength, bolt-nut-washer assemblies.
 4. Shear stud connectors.

- F. Survey of existing conditions.
- G. Source quality-control reports.
- H. Field quality-control reports.

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).
- B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- C. Shop-Painting Applicators: Qualified in accordance with SSPC-QP 3.
- D. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
 - 1. ANSI/AISC 303.
 - 2. ANSI/AISC 341.
 - 3. ANSI/AISC 360.
 - 4. RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- B. Connection Design Information:
 - 1. Coordinate design connections with the Drawings.

2. Design connections in accordance with ANSI/AISC 303 by fabricator's qualified professional engineer licensed in the State of Florida.
 - a. Select and complete connections using schematic details indicated and ANSI/AISC 360.
 - b. Use Load and Resistance Factor Design; unless otherwise indicated.

C. Moment Connections: As indicated on the Drawings.

D. Construction: As indicated on the Drawings.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A992, Grade 50.

B. Channels: ASTM A572, Grade 50, unless otherwise indicated.

C. Angles, Plates and Bar: ASTM A36, unless otherwise indicated.

D. Hollow Structural Sections (HSS): ASTM A500, Grade B structural tubing.

E. Steel Pipe: ASTM A53, Type E or Type S, Grade B.

1. Weight Class: As indicated.
2. Finish: As indicated.

F. Welding Electrodes: E70XX, unless otherwise indicated. Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F959, Type 325-1, compressible-washer type with plain finish.

B. High-Strength A490 Bolts, Nuts, and Washers: ASTM F3125, Grade A490, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F959, Type 490-1, compressible-washer type with plain finish.

C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125, Grade F1852, Type 1, heavy-hex head assemblies, consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers.

1. Finish: As indicated.

D. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

2.4 RODS

- A. Anchor Rods (headed or unheaded): Unless otherwise indicated, ASTM F1554, Grade 55, weldable and meeting the requirements of Supplement S1.
 - 1. Configuration: Hooked unless straight bars are indicated in the Drawings.
 - 2. Nuts: ASTM A563, Grade A, heavy-hex carbon steel.
 - 3. Plate Washers: ASTM A36 carbon steel.
 - 4. Washers: ASTM F436, Type 1, hardened carbon steel.
 - 5. Finish: As indicated.
- B. Threaded Rods: ASTM A572, Grade 50, unless otherwise indicated.
 - 1. Nuts: ASTM A563 heavy-hex carbon steel.
 - 2. Washers: ASTM F436, Type 1, hardened carbon steel.
 - 3. Finish: As indicated.

2.5 FORGED-STEEL STRUCTURAL HARDWARE

- A. Clevises and Turnbuckles: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1035.
- B. Eye Bolts and Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1030.
- C. Sleeve Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1018.

2.6 PRIMER

- A. Steel Primer:
 - 1. Comply with Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."
 - 2. SSPC-Paint 23, latex primer.
 - 3. Fabricator's standard lead- and chromate-free, non-asphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

2.7 SHRINKAGE-RESISTANT GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.8 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
 - 1. Camber structural-steel members where indicated.
 - 2. Fabricate beams with rolling camber up.
 - 3. Identify high-strength structural steel in accordance with ASTM A6 and maintain markings until structural-steel framing has been erected.
 - 4. Mark and match-mark materials for field assembly.

5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
 - C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
 - D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
 - E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 3.
 - F. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.
 - G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required to provide uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.
 - H. Welded-Steel Door Frames: Build up welded-steel door frames attached to structural-steel frame. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches o.c. unless otherwise indicated on Drawings.
 - I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.9 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
 1. Joint Type: Snug tightened, unless otherwise indicated.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

2.10 GALVANIZING

- A. Hot-Dip Galvanized Finish: For any items indicated to be galvanized, apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.

2.11 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 2. Surfaces to be field welded.
 3. Surfaces of high-strength bolted, slip-critical connections.
 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 5. Galvanized surfaces, unless indicated to be painted.
 6. Corrosion-resisting (weathering) steel surfaces.
 7. Surfaces enclosed in interior construction
- B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with SSPC-SP3.
- C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner.
- D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.12 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform shop tests and inspections. Engage an AWS Certified Welding Inspector for the visual inspection of welds.
 1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
 2. Bolted Connections: Inspect shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E165.
 - b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Ultrasonic Inspection: ASTM E164.
 - d. Radiographic Inspection: ASTM E94.
 4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:

- a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.
 - b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear stud connectors if weld fracture occurs on shear stud connectors already tested.
5. Prepare test and inspection reports. Welding reports shall be signed and stamped by the AWS Certified Welding Inspector.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.
 1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
- B. Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 2. Weld plate washers to top of baseplate.
 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.
- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.

- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
 - 1. Joint Type: Snug tightened, unless otherwise indicated.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

3.5 REPAIR

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780.
- B. Touchup Painting:
 - 1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 - 2. Cleaning and touchup painting are specified in Section 099113 "Exterior Painting", Section 099123 "Interior Painting", and Section 099600 "High-Performance Coatings".
- C. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

3.6 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds. This welding inspection is in addition to the inspections performed by the AWS Certified Welding Inspector.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

1. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts." Testing of questionable bolted connections may be requested at the discretion of the Architect.
2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M. Visual inspection shall be performed by the AWS Certified Welding Inspector.
 - a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - 1) Liquid Penetrant Inspection: ASTM E165.
 - 2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - 3) Ultrasonic Inspection: ASTM E164.
 - 4) Radiographic Inspection: ASTM E94.

END OF SECTION 05 12 00

SECTION 05 21 00 - STEEL JOIST 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. Steel joists.
- 2. Steel joist girders.
- 3. Steel joist accessories.

- B. Related Requirements:

- 1. Section 033000 "Cast-in-Place Concrete" for installing bearing plates in concrete.
- 2. Section 042000 "Unit Masonry" for installing bearing plates in unit masonry.
- 3. Section 051200 "Structural Steel Framing" for field-welded shear connectors.

1.3 DEFINITIONS

- A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."
- B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of joist, accessory, and product.

- B. Shop Drawings:

- 1. Include layout, designation, number, type, location, and spacing of joists.
- 2. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
- 3. Indicate locations and details of bearing plates to be embedded in other construction.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, fabricator, shop-painting applicators, professional engineer, and testing agency.

- B. Welding certificates. Welding operator's qualification certificates more than 12 months old, must be accompanied by documentation that a welder has been engaged in relevant welding since the date of certification.
- C. Manufacturer certificates.
- D. Mill Certificates: For each type of bolt.
- E. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.
- F. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."
 - 1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
- B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle joists as recommended in SJI's "Specifications."
- B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

1.8 SEQUENCING

- A. Deliver steel bearing plates to be built into either cast-in-place concrete and masonry construction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated on Drawings.
 - 1. Design special joists to withstand design loads with live-load deflections no greater than the following:
 - a. Floor Joists: Vertical deflection of 1/240 of the span.
 - b. Roof Joists: Vertical deflection of 1/240 of the span.

2.2 STEEL JOISTS

- A. K-Series Steel Joist: Manufactured steel joists of type indicated according to "Standard Specification for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
1. Joist Type: As noted on the drawings.
 2. K-Series Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.
 3. Provide holes in chord members for connecting and securing other construction to joists.
 4. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated on Drawings, complying with SJI's "Specifications."
 5. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated on Drawings, complying with SJI's "Specifications."
 6. Do not camber joists.
 7. Camber joists according to SJI's "Specifications" unless otherwise indicated on Drawings.
 8. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.
- B. Long-Span Steel Joist: Manufactured steel joists according to "Standard Specification for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as indicated on Drawings.
1. Joist Type: As indicated on Drawings.
 2. End Arrangement: As indicated on Drawings.
 3. Top-Chord Arrangement: As indicated on Drawings.
 4. Provide holes in chord members for connecting and securing other construction to joists.
 5. Camber long-span steel joists according to SJI's "Specifications" unless otherwise indicated on Drawings.
 6. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.
- C. Composite Steel Joist: Manufactured steel joists according to "Standard Specifications for Composite Steel Joists, CJ-Series" in SJI's "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice," with steel-angle top- and bottom-chord members and parallel top chord, and with square ends.
1. Camber composite steel joists as indicated on Drawings.

2.3 STEEL JOIST GIRDERS

- A. Manufactured joist girders according to "Standard Specification for Joist Girders" in SJI's "Specifications," with steel-angle top- and bottom-chord members; with end and top-chord arrangements as indicated on Drawings.
1. End Arrangement: As indicated on Drawings.
 2. Top-Chord Arrangement: As indicated on Drawings.
 3. Provide holes in chord members for connecting and securing other construction to joist girders.
 4. Camber joist girders as indicated on drawings.
 5. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.4 PRIMERS

A. Primer:

1. SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.
2. Provide shop primer that complies with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

2.5 STEEL JOIST ACCESSORIES

A. Bridging:

1. Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
2. Schematically indicated. Detail and fabricate according to SJI's "Specifications. Furnish additional erection bridging if required for stability.
3. Fabricate as indicated on Drawings and according to SJI's "Specifications. Furnish additional erection bridging if required for stability.

B. Fabricate steel bearing plates from ASTM A36 steel with integral anchorages of sizes and thicknesses indicated on Drawings. Hot-dip zinc coat according to ASTM A123.

C. Steel bearing plates with integral anchorages are specified in Section 055000 "Metal Fabrications."

D. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction.

1. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated on Drawings.
2. Finish: either Hot-dip zinc coating, ASTM A153, Class C or mechanically deposited zinc coating, ASTM B695, Class 50.

E. High-Strength Bolts, Nuts, and Washers: ASTM F3125, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers.

1. Finish: Either Hot-dip zinc coating, ASTM A153, Class C or mechanically deposited zinc coating, ASTM B695, Class 50.

F. Welding Electrodes: Comply with AWS standards.

G. Galvanizing Repair Paint: ASTM A780, unless otherwise indicated on Drawings.

H. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.6 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2, or power-tool cleaning, SSPC-SP 3.

B. Do not prime paint joists and accessories if they are to receive sprayed fire-resistive materials.

- C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.
- D. Shop priming of joists and joist accessories is specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates, embedded bearing plates, 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

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications, joist manufacturer's written instructions, and requirements in this Section."
 - 1. Before installation, splice joists delivered to Project site in more than one piece.
 - 2. Space, adjust, and align joists accurately in location before permanently fastening.
 - 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
 - 4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.
- C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Bolt joists to supporting steel framework using carbon-steel bolts.
- E. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for high-strength structural bolt installation and tightening requirements.
- F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 REPAIRS

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.
- B. Touchup Painting:

1. Immediately after installation, clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists bearing plates, abutting structural steel, and accessories.
 - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 - b. Apply a compatible primer of same type as primer used on adjacent surfaces.
2. Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Visually inspect field welds according to AWS D1.1/D1.1M.
 1. In addition to visual inspection, test field welds according to AWS D1.1/D1.1M and the following procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E165.
 - b. Magnetic Particle Inspection: ASTM E709, performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Ultrasonic Testing: ASTM E164.
 - d. Radiographic Testing: ASTM E94.
- C. Visually inspect bolted connections.
- D. Prepare test and inspection reports.

END OF SECTION 05 21 00

SECTION 05 31 00 - STEEL DECKING

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. Roof deck.
 - 2. Composite floor deck.
- B. Related Requirements:
 - 1. Section 033000 "Cast-in-Place Concrete" for structural concrete fill over steel deck.
 - 2. Section 051200 "Structural Steel Framing" for welding.
 - 3. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
 - 4. Section 099113 "Exterior Painting" for repair painting of primed deck and finish painting of deck.
 - 5. Section 099123 "Interior Painting" for repair painting of primed deck and finish painting of deck.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Roof deck.
 - 2. Composite floor deck.
- B. Shop Drawings:
 - 1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Certificates: For each type of steel deck.
- C. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - 1. Power-actuated mechanical fasteners.
 - 2. Acoustical roof deck.
- D. Research Reports: For steel deck, from ICC-ES.

- E. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
- C. FM Approvals' RoofNav Listing: Provide steel roof deck evaluated by FM Approvals and listed in its RoofNav for Class 1 fire rating and Class 1-90 windstorm ratings. Identify materials with FM Approvals Certification markings.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
 - 1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- B. Fire-Resistance Ratings: Comply with ASTM E119; 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 ROOF DECK

- A. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
 - 1. Galvanized-Steel Sheet: ASTM A653, Structural Steel (SS), Grade 33, G90 zinc coating, unless otherwise indicated.
 - 2. Deck Profile: As indicated.
 - 3. Profile Depth: As indicated.
 - 4. Design Uncoated-Steel Thickness: As indicated.
 - 5. Span Condition: As indicated.
 - 6. Side Laps: Overlapped

2.3 COMPOSITE FLOOR DECK

- A. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
 - 1. Galvanized-Steel Sheet: ASTM A653, Structural Steel (SS), Grade 33, G90 zinc coating, unless otherwise indicated.
 - 2. Profile Depth: As indicated.
 - 3. Design Uncoated-Steel Thickness: As indicated.
 - 4. Span Condition: As indicated.

2.4 ACCESSORIES

- A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter, unless otherwise indicated.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth, unless otherwise indicated.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.
- I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0747 inch thick, with factory-punched hole of 3/8-inch minimum diameter.
- J. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.
- K. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch-wide flanges and sloped recessed pans of 1-1/2-inch minimum depth, unless otherwise indicated. For drains, cut holes in the field.
- L. Galvanizing Repair Paint: ASTM A780 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight.
- M. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions 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. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
 - 1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 INSTALLATION OF ROOF DECK

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:
 - 1. Weld Diameter: As indicated.
 - 2. Weld Spacing: Space welds as indicated.
 - 3. Weld Washers: Install weld washers at each weld location, unless otherwise indicated.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at the indicated intervals.

- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Lapped 2 inches minimum, unless otherwise indicated.
- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld or mechanically fasten flanges to top of deck. Space welds or mechanical fasteners not more than 12 inches apart with at least one weld or fastener at each corner.
 - 1. Install reinforcing channels or zees in ribs to span between supports and weld or mechanically fasten.
- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
 - 1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.
- F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 INSTALLATION OF FLOOR DECK

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
 - 1. Weld Diameter: As indicated.
 - 2. Weld Spacing: Space and locate welds as indicated.
 - 3. Weld Washers: Install weld washers at each weld location, unless otherwise indicated.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at indicated intervals.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Lapped 2 inches minimum, unless otherwise indicated.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.
- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.
- F. Install piercing hanger tabs at 14 inches apart in both directions, within 9 inches of walls at ends, and not more than 12 inches from walls at sides unless otherwise indicated.

3.5 REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.
- B. Repair Painting:

1. Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
2. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
3. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
4. Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Field welds will be subject to inspection.
- C. Prepare test and inspection reports.

END OF SECTION 05 31 00

SECTION 05 40 00 - 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. Load-bearing wall framing.
 - 2. Exterior non-load-bearing wall framing.
 - 3. Interior non-load-bearing wall framing.
 - 4. Roof rafter framing.
 - 5. Ceiling joist framing.
 - 6. Soffit framing.

- B. Related Requirements:

- 1. Section 055000 "Metal Fabrications" for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.
 - 2. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies, with height limitations.
 - 3. Section 092216 "Non-Structural Metal Framing" for standard, interior non-load-bearing, metal-stud framing, with height limitations and ceiling-suspension assemblies.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:

- 1. Cold-formed steel framing materials.
 - 2. Load-bearing wall framing.
 - 3. Exterior non-load-bearing wall framing.
 - 4. Interior non-load-bearing wall framing.
 - 5. Vertical deflection clips.
 - 6. Single deflection track.
 - 7. Double deflection track.
 - 8. Drift clips.
 - 9. Roof-rafter framing.
 - 10. Ceiling joist framing.
 - 11. Soffit framing.
 - 12. Post-installed anchors.
 - 13. Power-actuated anchors.

14. Sill sealer gasket.
15. Sill sealer gasket/termite barrier.

B. Shop Drawings:

1. Include layout, spacings, 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.

- A. Delegated-Design Submittal: For cold-formed steel framing, including analysis data and calculations signed and sealed by the qualified professional engineer, licensed in the State of Florida, responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For delegated-design professional engineer and testing agency.

- B. Welding certificates.

- C. Product Certificates: For each type of code-compliance certification for studs and tracks.

- D. 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.

- E. Research Reports:

1. For nonstandard cold-formed steel framing post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.
2. For sill sealer gasket/termite barrier, showing compliance with ICC-ES AC380.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E329 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.

- C. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association, or the Steel Stud Manufacturers Association.

- D. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
- E. Comply with AISI S230 "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

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 on Drawings.
 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Exterior Load-Bearing Wall Framing: Horizontal deflection of 1/240 of the wall height, unless otherwise noted.
 - b. Interior Load-Bearing Wall Framing: Horizontal deflection of 1/360 of the wall height under a horizontal load of 5 lbf/sq. ft., unless otherwise noted.
 - c. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height, unless otherwise noted.
 - d. Interior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height under a horizontal load of 5 lbf/sq. ft., unless otherwise noted.
 - e. Roof Rafter Framing: Vertical deflection of 1/240 of the horizontally projected span for live loads.
 - f. Ceiling Joist Framing: Vertical deflection of 1/240 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 3/4 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 Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:
 1. Floor and Roof Systems: AISI S210.
 2. Wall Studs: AISI S211.
 3. Headers: AISI S212.
 4. Lateral Design: AISI S213.

- D. Fire-Resistance Ratings: Comply with ASTM E119; 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 acceptable to authorities having jurisdiction.

2.2 COLD-FORMED STEEL FRAMING MATERIALS

- A. Steel Sheet: ASTM A1003, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
 - 1. Grade: As required by structural performance.
 - 2. Coating: G60, A60, AZ50, or GF30.
- B. Steel Sheet for Clips: ASTM A653, structural steel, zinc coated, of grade and coating as follows:
 - 1. Grade: As required by structural performance.
 - 2. Coating: G60.

2.3 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: As required by structural performance.
 - 2. Flange Width: As required by structural performance.
 - 3. Section Properties: As required by structural performance.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: As required by structural performance.
 - 2. Flange Width: As required by structural performance.
- C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: As required by structural performance.
 - 2. Flange Width: As required by structural performance.
 - 3. Section Properties: As required by structural performance.
- D. Steel Single- or Double-L Headers: Manufacturer's standard L-shapes used to form header beams, of web depths indicated, and as follows:
 - 1. Minimum Base-Metal Thickness: As required by structural performance.
 - 2. Top Flange Width: As required by structural performance.
 - 3. Section Properties: As required by structural performance.

2.4 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: As required by structural performance.
 2. Flange Width: As required by structural performance.
 3. Section Properties: As required by structural performance.
- 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: As required by structural performance.
 2. Flange Width: As required by structural performance.
- C. Vertical Deflection Clips: Manufacturer's standard clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
1. Minimum Base-Metal Thickness: As required by structural performance.
 2. Flange Width: As required by structural performance.
- E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
 - a. Minimum Base-Metal Thickness: As required by structural performance.
 - b. Flange Width: As required by structural performance.
 2. Inner Track: Of web depth indicated, and as follows:
 - a. Minimum Base-Metal Thickness: As required by structural performance.
 - b. Flange Width: As required by structural performance.
- F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.5 INTERIOR 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: As required by structural performance.
 2. Flange Width: As required by structural performance.
 3. Section Properties: As required by structural performance.
- 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: As required by structural performance.
 2. Flange Width: As required by structural performance.

- C. Vertical Deflection Clips: Manufacturer's standard clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
 - 1. Minimum Base-Metal Thickness: As required by structural performance.
 - 2. Flange Width: As required by structural performance.
- E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
 - 1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
 - a. Minimum Base-Metal Thickness: As required by structural performance.
 - b. Flange Width: As required by structural performance.
 - 2. Inner Track: Of web depth indicated, and as follows:
 - a. Minimum Base-Metal Thickness: As required by structural performance.
 - b. Flange Width: As required by structural performance.
- F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.6 ROOF-RAFTER FRAMING

- A. Steel Rafters: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: As required by structural performance.
 - 2. Flange Width: As required by structural performance; however, 1-5/8 inches minimum.
 - 3. Section Properties: As required by structural performance.

2.7 CEILING JOIST FRAMING

- A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: As required by structural performance.
 - 2. Flange Width: As required by structural performance; however, 1-5/8 inches minimum.
 - 3. Section Properties: As required by structural performance.

2.8 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: As required by structural performance.
2. Flange Width: As required by structural performance; however, 1-5/8 inches minimum.
3. Section Properties: As required by structural performance.

2.9 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from ASTM A1003, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation 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. Foundation clips.
 7. Gusset plates.
 8. Stud kickers and knee braces.
 9. Joist hangers and end closures.
 10. Hole-reinforcing plates.
 11. Backer plates.

2.10 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A36, zinc coated by hot-dip process according to ASTM A123.
- B. Anchor Bolts: ASTM F1554, Grade 36 (unless otherwise notes), threaded carbon-steel hex-headed bolts, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by [hot-dip process according to ASTM A153, Class C].
- C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC193, ICC-ES AC58, or ICC-ES AC308 as appropriate for the substrate.
 1. Uses: Securing cold-formed steel framing to structure.
 2. Type: Either torque-controlled expansion anchor, torque-controlled adhesive anchor, or adhesive anchor.
 3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
 4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F593, and nuts, ASTM F594.
- D. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- E. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
 1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

- F. Welding Electrodes: Comply with AWS standards.

2.11 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A780.
- B. Cement Grout: Portland cement, ASTM C150, Type I; and clean, natural sand, ASTM C404. 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: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107, and with a fluid consistency and 30-minute working time.
- D. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.
- E. Sill Sealer Gasket: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.
- F. Sill Sealer Gasket/Termite Barrier: Minimum 68-mil nominal thickness, self-adhering sheet consisting of 64 mils of rubberized asphalt laminated on one side to a 4-mil-thick, polyethylene-film reinforcement, and with release liner on adhesive side.
 - 1. As indicated on the Drawings.
 - 2. Physical Properties:
 - a. Peel Adhesion: 17.0 lb/in of width when tested in accordance with ASTM D412.
 - b. Low-Temperature Flexibility: Pass at minus 25 deg F when tested in accordance with ASTM D146.
 - c. Water Vapor Permeance: 0.05 perm maximum when tested in accordance with ASTM E96, Method B.
 - d. Resistance to Termite Penetration: Comply with ICC-ES AC380.

2.12 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.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screws 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 by means that prevent damage or permanent distortion.
- C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable 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 substrates, areas, conditions, 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 PREPARATION

- A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.
- C. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.
- D. Install sill sealer gasket at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.
- E. Install sill sealer gasket/termite barrier in accordance with manufacturer's written instructions at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 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, AISI S202, and 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.
 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch 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, install according to Shop Drawings, and comply 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 equal 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 framing-assembly 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.

3.4 INSTALLATION OF LOAD-BEARING WALL FRAMING

- A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:
 1. Anchor Spacing: To match stud spacing, unless otherwise indicated.
- B. Squarely seat studs against top and bottom tracks, with gap not exceeding 1/8 inch between the end of wall-framing member and the web of track.
 1. Fasten both flanges of studs to top and bottom tracks.
 2. Space studs as follows:
 - a. Stud Spacing: 16 inches unless otherwise indicated on Drawings.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.
- D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

- E. Align floor and roof framing over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.
- F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure.
- G. Install headers over wall openings wider than stud spacing. Locate headers above openings. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
 - 1. Frame wall openings with not less than a double stud at each jamb of frame. Fasten jamb members together to uniformly distribute loads.
 - 2. Install tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.
- H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
 - 1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.
- I. Install horizontal bridging in stud system, spaced vertically 48 inches, unless otherwise indicated on Drawings. Fasten at each stud intersection.
 - 1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches deep.
 - 2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges, and secure solid blocking to stud webs or flanges.
 - 3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- J. Install steel sheet diagonal bracing straps to both stud flanges; terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.
- K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 INSTALLATION OF EXTERIOR NONLOADBEARING WALL FRAMING

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: 16 inches unless otherwise indicated on Drawings.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb 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. Install single deep-leg deflection tracks and anchor to building structure.
 2. Install double deep-leg deflection tracks and anchor outer track to building structure.
 3. Connect vertical deflection clips to studs and anchor to building structure.
 4. Connect drift clips to cold-formed steel framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated but not more than 48 inches apart. Fasten at each stud intersection.
1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
1. Install solid blocking at 96-inch centers, unless otherwise indicated on Drawings.
- G. 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.

3.6 INSTALLATION OF INTERIOR NONLOADBEARING WALL FRAMING

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
1. Stud Spacing: 16 inches unless otherwise indicated on Drawings.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb 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. Install single deep-leg deflection tracks and anchor to building structure.
 2. Install double deep-leg deflection tracks and anchor outer track to building structure.
 3. Connect vertical deflection clips to studs and anchor to building structure.
 4. Connect drift clips to cold-formed steel metal framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated but not more than 48 inches apart. Fasten at each stud intersection.
1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

- F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches (unless otherwise indicated on Drawings) of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
 - 1. Install solid blocking at 96-inch centers, unless otherwise indicated on Drawings.
- G. 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.

3.7 INSTALLATION OF JOIST FRAMING

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated.
- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
 - 1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches.
 - 2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections.
- C. Space joists not more than 2 inches from abutting walls, and as follows:
 - 1. Joist Spacing: As indicated on Drawings.
- D. Frame openings with built-up joist headers, consisting of joist and joist track or another combination of connected joists if indicated.
- E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement.
 - 1. Install web stiffeners to transfer axial loads of walls above.
- F. Install bridging at intervals indicated. Fasten bridging at each joist intersection as follows:
 - 1. Joist-Track Solid Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
 - 2. Combination Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.
- G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.
- H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.8 INSTALLATION TOLERANCES

- A. 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.

3.9 REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.

3.10 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. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.11 PROTECTION

- A. 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 05 40 00

SECTION 05 50 00 - METAL FABRICATIONS

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. Steel framing and supports for ceiling-hung toilet compartments.
2. Steel framing and supports for operable partitions.
3. Steel framing and supports for overhead doors and grilles.
4. Steel framing and supports for countertops.
5. Steel tube reinforcement for low partitions.
6. Steel framing and supports for mechanical and electrical equipment.
7. Steel framing and supports for applications where framing and supports are not specified in other Sections.
8. Elevator machine beams, hoist beams, and divider beams.
9. Steel shapes for supporting elevator door sills.
10. Steel girders for supporting wood frame construction.
11. Steel pipe columns for supporting wood frame construction.
12. Slotted channel framing.
13. Prefabricated building columns.
14. Shelf angles.
15. Metal ladders.
16. Ladder safety cages.
17. Alternating tread devices.
18. Metal pipe crossovers.
19. Metal floor plate and supports.
20. Elevator pit sump covers.
21. Structural-steel door frames.
22. Miscellaneous steel trim including steel angle corner guards, steel edgings, and loading-dock edge angles.
23. Metal bollards.
24. Vehicular barrier cable systems.
25. Pipe and Downspout guards.
26. Abrasive metal nosings, treads, and thresholds.
27. Cast-iron wheel guards.
28. Metal downspout boots.
29. Loose bearing and leveling plates for applications where they are not specified in other Sections.

- B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related Requirements:

1. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
2. Section 051200 "Structural Steel Framing" for steel framing, supports, elevator machine beams, hoist beams, divider beams, door frames, and other steel items attached to the structural-steel framing.
3. Section 077200 "Roof Accessories" for miscellaneous metal fabrications.

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Nonslip aggregates and nonslip-aggregate surface finishes.
2. Fasteners.
3. Shop primers.
4. Shrinkage-resisting grout.
5. Slotted channel framing.
6. Manufactured metal ladders.
7. Ladder safety cages.
8. Alternating tread devices.
9. Metal pipe crossovers.
10. Metal bollards.
11. Vehicular barrier cable systems.
12. Pipe and Downspout guards.
13. Abrasive metal nosings, treads, and thresholds.
14. Cast-iron wheel guards.
15. Metal downspout boots.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Steel framing and supports for ceiling-hung toilet compartments.
2. Steel framing and supports for operable partitions.
3. Steel framing and supports for overhead doors and grilles.
4. Steel framing and supports for countertops.
5. Steel tube reinforcement for low partitions.
6. Steel framing and supports for mechanical and electrical equipment.
7. Steel framing and supports for applications where framing and supports are not specified in other Sections.
8. Elevator machine beams, hoist beams, and divider beams.

9. Steel shapes for supporting elevator door sills.
10. Steel girders for supporting wood frame construction.
11. Steel pipe columns for supporting wood frame construction.
12. Prefabricated building columns.
13. Shelf angles.
14. Metal ladders.
15. Ladder safety cages.
16. Alternating tread devices.
17. Metal pipe crossovers.
18. Metal floor plate and supports.
19. Elevator pit sump covers.
20. Structural-steel door frames.
21. Miscellaneous steel trim including steel angle corner guards, steel edgings, and loading-dock edge angles.
22. Metal bollards.
23. Loose steel lintels.
24. Vehicular barrier cable systems.

- C. Samples for Verification: For each type and finish of extruded nosing and tread.
- D. Delegated-Design Submittal: For ladders alternating tread devices and vehicular barrier cable systems, including analysis data and calculations signed and sealed by the qualified professional engineer, licensed in the State of Florida, responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the State of Florida.
- B. Mill Certificates: Signed by stainless steel manufacturers, certifying that products furnished comply with requirements.
- A. Welding certificates. Welding operator's qualification certificates more than 12 months old, must be accompanied by documentation that a welder has been engaged in relevant welding since the date of certification.
- B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- C. Research Reports: For post-installed anchors.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer (licensed in the State of Florida), as defined in Section 014000 "Quality Requirements," to design ladders, alternating tread devices, and vehicular barrier cable systems.
- B. Structural Performance of Aluminum Ladders: Ladders, including landings, shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.
- C. Structural Performance of Alternating Tread Devices: Alternating tread devices shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Uniform Load: 100 lbf/sq. ft.
 - 2. Concentrated Load: 300 lbf applied on an area of 4 sq. in.
 - 3. Uniform and concentrated loads need not be assumed to act concurrently.
 - 4. Alternating Tread Device Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
 - 5. Comply with applicable railing loadings in Section 055213 "Pipe and Tube Railings."
- D. Vehicular Barrier Cable Systems: Design vehicular barrier cable systems to resist a single 6000-lbf service load and 10,000-lbf ultimate load applied horizontally in any direction to the cable system, with anchorages or attachments capable of transferring this load to the structure. Limit deflection to 18 inches. Design shall assume loads are applied at a height of 18 inches above the floor or ramp surface on an area not to exceed 1 sq. ft.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36.
- C. Stainless Steel Sheet, Strip, and Plate: ASTM A240 or ASTM A666, Type 304.
- D. Stainless Steel Bars and Shapes: ASTM A276, Type 304.
- E. Rolled-Steel Floor Plate: ASTM A786, rolled from plate complying with ASTM A36 or ASTM A283, Grade C or D.

- F. Rolled-Stainless Steel Floor Plate: ASTM A793.
- G. Abrasive-Surface Floor Plate: Steel plate with abrasive granules rolled into surface or with abrasive material metallurgically bonded to steel.
 - 1. Source Limitations: Obtain floor plate from single source from single manufacturer.
- H. Steel Tubing: ASTM A500, cold-formed steel tubing.
- I. Steel Pipe: ASTM A53, Standard Weight (Schedule 40) unless otherwise indicated.
- J. Zinc-Coated Steel Wire Rope: ASTM A741.
 - 1. Wire Rope Fittings: Hot-dip galvanized-steel connectors with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.
- K. Stainless Steel Wire Rope: Wire rope manufactured from stainless steel wire complying with ASTM A492, Type 316.
 - 1. Wire Rope Fittings: Stainless steel connectors, Type 316, with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.
- L. Steel Prestressing Strand: ASTM A416, Grade 270, low-relaxation, seven-wire, with 0.9-lb/sq. ft. zinc coating.
 - 1. Steel Prestressing Strand Fittings: Hot-dip galvanized-steel anchors and connectors with capability to sustain, without failure, a load equal to minimum breaking strength of steel prestressing strand with which they are used.
- M. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
 - 1. Size of Channels: 1-5/8 by 1-5/8 inches, unless otherwise indicated.
 - 2. Material: Galvanized steel, ASTM A653, structural steel, Grade 33, with G90 coating; 0.108-inch nominal thickness, unless otherwise indicated.
 - 3. Material: Cold-rolled steel, ASTM A1008, structural steel, Grade 33; 0.0966-inch minimum thickness; hot-dip galvanized after fabrication.
- N. Cast Iron: Either gray iron, ASTM A48, or malleable iron, ASTM A47, unless otherwise indicated.
- O. Aluminum Plate and Sheet: ASTM B209, Alloy 6061-T6.
- P. Aluminum Extrusions: ASTM B221, Alloy 6063-T6.
- Q. Aluminum-Alloy Rolled Tread Plate: ASTM B632, Alloy 6061-T6.
- R. Aluminum Castings: ASTM B26, Alloy 443.0-F.
- S. Bronze Extrusions: ASTM B455, Alloy UNS No. C38500 (extruded architectural bronze).
- T. Bronze Castings: ASTM B584, Alloy UNS No. C83600 (lead red brass) or UNS No. C84400 (lead semired brass).
- U. Nickel Silver Extrusions: ASTM B151, Alloy UNS No. C74500.
- V. Nickel Silver Castings: ASTM B584, Alloy UNS No. C97600 (20 percent lead nickel bronze).

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless steel fasteners for fastening aluminum, stainless steel, or nickel silver.
 - 2. Provide bronze fasteners for fastening bronze.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.
- C. High-Strength Bolts, Nuts, and Washers: ASTM F3125, Grade A325, Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, heavy-hex carbon-steel nuts; and where indicated, flat washers.
- D. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 1.
- E. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- F. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488, conducted by a qualified independent testing agency.
- G. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47 malleable iron or ASTM A27 cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329.
- H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.
- I. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

- C. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.
- D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187.
- H. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- I. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight concrete with a minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply 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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Furnish inserts for units installed after concrete is placed.
- C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated with attached bearing plates, anchors, and braces as indicated. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.
- D. Fabricate steel girders for wood frame construction from continuous steel shapes of sizes indicated.
 - 1. Provide bearing plates welded to beams where indicated.
 - 2. Drill or punch girders and plates for field-bolted connections where indicated.
 - 3. Where wood nailers are attached to girders with bolts or lag screws, drill or punch holes at 24 inches o.c., unless otherwise indicated.
- E. Fabricate steel pipe columns for supporting wood frame construction from steel pipe with steel baseplates and top plates as indicated. Drill or punch baseplates and top plates for anchor and connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness unless otherwise indicated.
 - 1. Unless otherwise indicated, fabricate from Schedule 40 steel pipe.
 - 2. Unless otherwise indicated, provide 5/8-inch baseplates with four 3/4-inch anchor bolts and 1/4-inch top plates.
- F. Galvanize miscellaneous framing and supports where indicated.
- G. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 18 inches o.c., unless otherwise indicated.
 - 1. Provide mitered and welded units at corners.
 - 2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.
- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.

- C. Galvanize shelf angles located in exterior walls.
- D. Prime shelf angles located in exterior walls with zinc-rich primer.
- E. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.8 METAL LADDERS

A. General:

- 1. Comply with ANSI A14.3, except for elevator pit ladders.
- 2. For elevator pit ladders, comply with ASME A17.1/CSA B44.

B. Steel Ladders:

- 1. Space siderails 18 inches apart unless otherwise indicated.
- 2. Siderails: Continuous, 1/2-by-2-1/2-inch steel flat bars, with eased edges.
- 3. Rungs: 3/4-inch-diameter steel bars, unless otherwise indicated.
- 4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
- 5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
- 6. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.
- 7. Source Limitations: Obtain nonslip surfaces from single source from single manufacturer.
- 8. Provide platforms as indicated fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 3/4 inch in least dimension.
- 9. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets, unless otherwise indicated.
- 10. Galvanize and prime ladders, including brackets.
- 11. Prime ladders, including brackets and fasteners, with zinc-rich primer.

C. Aluminum Ladders:

- 1. Source Limitations: Obtain aluminum ladders from a single source from a single manufacturer.
- 2. Space siderails 18 inches apart unless otherwise indicated.
- 3. Siderails: Continuous extruded-aluminum channels or tubes, not less than 2-1/2 inches deep, 3/4 inch wide, and 1/8 inch thick.
- 4. Rungs: Extruded-aluminum tubes, not less than 3/4 inch deep and not less than 1/8 inch thick, with ribbed tread surfaces.
- 5. Fit rungs in centerline of siderails; fasten by welding or with stainless steel fasteners or brackets and aluminum rivets.
- 6. Provide platforms as indicated fabricated from pressure-locked aluminum bar grating or extruded-aluminum plank grating, supported by extruded-aluminum framing. Limit openings in gratings to no more than 3/4 inch in least dimension.
- 7. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted aluminum brackets.
- 8. Provide minimum 72-inch-high, hinged security door with padlock hasp at foot of ladder to prevent unauthorized ladder use, unless otherwise indicated.

2.9 LADDER SAFETY CAGES

A. General:

1. Fabricate ladder safety cages to comply with ANSI A14.3. Assemble by welding or with stainless steel fasteners.
2. Provide primary hoops at tops and bottoms of cages and spaced not more than 20 feet o.c. Provide secondary intermediate hoops spaced not more than 48 inches o.c. between primary hoops.
3. Fasten assembled safety cage to ladder rails and adjacent construction by welding or with stainless steel fasteners unless otherwise indicated.

B. Steel Ladder Safety Cages:

1. Primary Hoops: 1/4-by-4-inch flat bar hoops.
2. Secondary Intermediate Hoops: 1/4-by-2-inch flat bar hoops.
3. Vertical Bars: 3/16-by-1-1/2-inch flat bars secured to each hoop.
4. Galvanize and prime ladder safety cages, including brackets and fasteners.
5. Prime ladder safety cages, including brackets and fasteners, with zinc-rich primer.

C. Aluminum Ladder Safety Cages:

1. Primary Hoops: 1/4-by-4-inch flat bar hoops.
2. Secondary Intermediate Hoops: 1/4-by-2-inch flat bar hoops.
3. Vertical Bars: 1/4-by-2-inch flat bars secured to each hoop.

2.10 ALTERNATING TREAD DEVICES

A. Alternating Tread Devices: Fabricate alternating tread devices of open-type construction with channel or plate stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.

1. Tread depth shall be not less than 5 inches exclusive of nosing or less than 8-1/2 inches including the nosing, tread width shall be not less than 7 inches, and riser height shall be not more than 9-1/2 inches.
2. Tread depth shall be not less than 5 inches exclusive of nosing or less than 8-1/2 inches including the nosing, tread width shall be not less than 7 inches, and riser height shall be not more than 9-1/2 inches.
3. Tread depth shall be not less than 8-1/2 inches exclusive of nosing or less than 10-1/2 inches including the nosing, tread width shall be not less than 7 inches, and riser height shall be not more than 8 inches.
4. Fabricate from stainless steel and assemble by welding or with stainless steel fasteners, unless otherwise noted.
5. Comply with applicable railing requirements in Section 055213 "Pipe and Tube Railings."

B. Galvanize and prime steel alternating tread devices, including treads, railings, brackets, and fasteners.

C. Prime steel alternating tread devices, including treads, railings, brackets, and fasteners, with zinc-rich primer.

2.11 METAL PIPE CROSSOVERS

A. Provide metal pipe crossovers where indicated. Fabricate of open-type construction with channel or plate stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.

1. Treads shall be not less than 5 inches exclusive of nosing or less than 8-1/2 inches including the nosing, and riser height shall be not more than 9-1/2 inches.
 2. Unless otherwise indicated, fabricate from galvanized steel, including railings.
 3. Unless otherwise indicated, fabricate treads and platforms from pressure-locked galvanized steel bar grating. Limit openings in gratings to no more than 3/4 inch in least dimension.
 4. Fabricate treads and platforms from galvanized steel floor plate.
 5. Comply with applicable railing requirements in Section 055213 "Pipe and Tube Railings."
- B. Galvanize and prime all elements, including treads, railings, brackets, and fasteners.
- C. Prime all elements, including treads, railings, brackets, and fasteners, with zinc-rich primer.

2.12 METAL FLOOR PLATE

- A. Fabricate from rolled-steel floor plate as indicated below:
1. Thickness: 3/16 inch, galvanized, unless otherwise indicated.
- B. Provide grating sections where indicated, fabricated from welded or pressure-locked galvanized steel bar grating. Limit openings in gratings to no more than 3/4 inch in least dimension.
- C. Provide galvanized steel angle supports as indicated.
- D. Include galvanized steel angle stiffeners, and fixed and removable sections as indicated.
- E. Provide flush galvanized steel bar drop handles for lifting removable sections, one at each end of each section.

2.13 ELEVATOR PIT SUMP COVERS

- A. Fabricate from 3/16-inch abrasive-surface floor plate with four 1-inch-diameter holes for water drainage and for lifting.
- B. Fabricate from welded or pressure-locked steel bar grating. Limit openings in gratings to no more than 3/4 inch in least dimension.
- C. Provide steel angle supports unless otherwise indicated.

2.14 STRUCTURAL-STEEL DOOR FRAMES

- A. Fabricate structural-steel door frames from steel shapes, plates, and bars of size and to dimensions indicated, fully welded together, with 5/8-by-1-1/2-inch steel channel stops, unless otherwise indicated. Plug-weld built-up members and continuously weld exposed joints. Secure removable stops to frame with countersunk machine screws, uniformly spaced at not more than 10 inches o.c. Reinforce frames and drill and tap as necessary to accept finish hardware.
1. Provide with integrally welded steel strap anchors for securing door frames into adjoining concrete or masonry.
- B. Extend bottom of frames to floor elevation indicated with steel angle clips welded to frames for anchoring frame to floor with expansion shields and bolts.

- C. Galvanize and prime steel frames.
- D. Prime steel frames with zinc-rich primer.

2.15 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
 - 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Galvanize and prime miscellaneous steel trim.
- D. Prime miscellaneous steel trim with zinc-rich primer.

2.16 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 80 steel pipe, unless otherwise indicated.
 - 1. Cap bollards with 1/4-inch-thick, steel plate with domed top.
 - 2. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
 - 3. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.
- B. Fabricate bollards with 1/2-inch-thick, steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch anchor bolts.
 - 1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.
- C. Fabricate sleeves for bollard anchorage from steel or stainless steel pipe or tubing with 1/4-inch-thick, steel or stainless steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches deep and 3/4 inch larger than OD of bollard.
- D. Fabricate internal sleeves for removable bollards from Schedule 80 steel pipe or 1/4-inch wall-thickness steel tubing with an OD approximately 1/16 inch less than ID of bollards. Match drill sleeve and bollard for 3/4-inch steel machine bolt.
- E. Prime steel bollards with zinc-rich primer.

2.17 VEHICULAR BARRIER CABLE SYSTEMS

- A. Vehicular Barrier Cable Systems: Of diameter required by performance requirements, but not less than 1/2-inch-diameter, zinc-coated steel wire rope with turnbuckles, toggles, machine swage terminals, and other fittings and accessories for securing to structural columns and walls and for tightening barrier cable.

2.18 PIPE AND DOWNSPOUT GUARDS

- A. Fabricate pipe and downspout guards from 3/8-inch-thick by 12-inch-wide, steel plate, bent to fit flat against the wall or column at both ends and to fit around pipe with 2-inch clearance between pipe and pipe guard. Drill each end for two 3/4-inch anchor bolts.
- B. Galvanize and prime steel pipe and downspout guards.
- C. Prime steel pipe and downspout guards with zinc-rich primer.

2.19 ABRASIVE METAL NOSINGS, TREADS, AND THRESHOLDS

- A. Cast-Metal Units: Cast iron, with an integral-abrasive, as-cast finish. Fabricate units in lengths necessary to accurately fit openings or conditions.
 - 1. Source Limitations: Obtain units from a single source from a single manufacturer.
 - 2. Nosings: Cross-hatched units, 4 inches wide with 1-inch lip, for casting into concrete, unless otherwise indicated.
 - 3. Treads: Cross-hatched units, full depth of tread with 3/4-by-3/4-inch nosing, for application over bent plate treads or existing stairs.
 - 4. Thresholds: 5 inches, as indicated.
- B. Extruded Units: Aluminum, with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.
 - 1. Source Limitations: Obtain units from a single source from a single manufacturer.
 - 2. Provide ribbed units, with abrasive filler strips projecting 1/16 inch above aluminum extrusion.
 - 3. Provide solid-abrasive-type units without ribs.
 - 4. Nosings:
 - a. Square-back units, 4 inches wide, for casting into concrete steps.
 - b. Beveled-back units, 4 inches wide with 1-3/8-inch lip, for surface mounting on existing stairs.
 - c. Two-piece units, 3 inches wide, with subchannel for casting into concrete steps.
 - 5. Treads: Square or Beveled-back units, full depth of tread with 1-3/8-inch lip, for application over existing stairs.
- C. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.
- D. Drill for mechanical anchors and countersink. Locate holes not more than 4 inches from ends and not more than 12 inches o.c., evenly spaced between ends, unless otherwise indicated. Provide closer spacing if recommended by manufacturer.
 - 1. Provide two rows of holes for units more than 5 inches wide, with two holes aligned at ends and intermediate holes staggered.
- E. Apply bituminous paint to concealed surfaces of cast-metal units.
- F. Apply clear lacquer to concealed surfaces of extruded units.

2.20 CAST-IRON WHEEL GUARDS

- A. Provide wheel guards made from cast-iron, 3/4-inch-thick, hollow-core construction, of size and shape indicated. Provide holes for countersunk anchor bolts and grouting.
- B. Prime cast-iron wheel guards with zinc-rich primer.

2.21 METAL DOWNSPOUT BOOTS

- A. Source Limitations: Obtain units from a single source from a single manufacturer.
- B. Provide downspout boots made from cast aluminum in heights indicated with inlets of size and shape to suit downspouts. Provide units with flanges and holes for countersunk anchor bolts.
 - 1. Outlet: As indicated.
- C. Prime cast-iron downspout boots with zinc-rich primer.

2.22 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize bearing and leveling plates.
- C. Prime plates with zinc-rich primer.

2.23 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span, but not less than 8 inches unless otherwise indicated.
- C. Galvanize and prime loose steel lintels located in exterior walls.
- D. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.24 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.25 GENERAL FINISH REQUIREMENTS

- A. Finish metal fabrications after assembly.

- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.26 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153 for steel and iron hardware and with ASTM A123 for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with zinc-rich primer unless otherwise indicated.
- D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
 - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 3. Other Interior Steel Items: SSPC-SP 3, "Power Tool Cleaning."
 - 4. Galvanized-Steel Items: SSPC-SP 16, "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."
- E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.27 ALUMINUM FINISHES

- A. As-Fabricated Finish: AA-M12.
- B. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

- C. Field Welding: Comply with the following requirements:
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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
1. Cast Aluminum: Heavy coat of bituminous paint.
 2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for ceiling hung toilet partitions, operable partitions, overhead doors, overhead grilles, cable trays and other miscellaneous items noted in the Drawings securely to, and rigidly brace from, building structure.
- C. Anchor shelf angles as indicated in the Drawings. If anchorage is not indicated, anchor securely to existing construction with either expansion anchors, anchor bolts, or through bolts.
- D. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.
- E. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installation of Bearing and Leveling Plates" Article.
1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLATION OF METAL BOLLARDS

- A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
1. Do not fill removable bollards with concrete.

- B. Anchor bollards as indicated in the Drawings. If anchorage is not indicated, anchor bollards to existing construction with either expansion anchors, anchor bolts, or through bolts. Provide four 3/4-inch bolts at each bollard unless otherwise indicated.
 - 1. Embed anchor bolts at least 4 inches in concrete.
- C. Fill annular space around bollard solidly with shrinkage-resistant grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.
- D. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
- E. Anchor internal sleeves for removable bollards in place with concrete footings. Center and align sleeves in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace sleeves in position until concrete has cured.
- F. Place removable bollards over internal sleeves and secure with 3/4-inch machine bolts and nuts. After tightening nuts, drill holes in bolts for inserting padlocks. Owner furnishes padlocks.

3.4 INSTALLATION OF VEHICULAR BARRIER CABLE SYSTEMS

- A. Install vehicular barrier cable systems at locations indicated, mounted at heights indicated on Drawings above the parking surface. Anchor wire ropes to structural columns and walls and tension to withstand vehicle loading as specified in "Performance Requirements" Article with no cable tensioned less than 3000 lbf. Do not displace supporting components.

3.5 INSTALLATION OF PIPE GUARDS

- A. Provide pipe guards at exposed vertical pipes in at locations indicated on Drawings where not protected by curbs or other barriers. Install by bolting to wall or column with expansion anchors. Provide four 3/4-inch bolts at each pipe guard. Mount pipe guards with top edge 26 inches above driving surface.

3.6 INSTALLATION OF NOSINGS, TREADS, AND THRESHOLDS

- A. Center nosings on tread widths unless otherwise indicated.
- B. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.
- C. Seal thresholds exposed to exterior with elastomeric sealant complying with Section 079200 "Joint Sealants" to provide a watertight installation.

3.7 INSTALLATION OF CAST-IRON WHEEL GUARDS

- A. Anchor wheel guards to concrete or masonry construction to comply with manufacturer's written instructions. Fill cores solidly with concrete.

3.8 INSTALLATION OF BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.9 REPAIRS

- A. Touchup Painting:
 - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
 - 2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in either Section 099113 "Exterior Painting.", or Section 099123 "Interior Painting."
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.

END OF SECTION 05 50 00

SECTION 05 52 13 - PIPE AND TUBE RAILINGS

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. Steel railings.
 - 2. Aluminum railings.
 - 3. Stainless steel railings.

- B. Related Requirements:

- 1. Section 055113 "Metal Pan Stairs" for steel tube railings associated with metal pan stairs.
 - 2. Section 057300 "Decorative Metal Railings" for ornamental railings fabricated from pipes and tubes and guard-infill metals.

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

- A. Product Data:

- 1. Manufacturer's product lines of mechanically connected railings.
 - 2. Expanded metal infill panels.
 - 3. Perforated metal infill panels.
 - 4. Woven-wire mesh infill panels.
 - 5. Fasteners.
 - 6. Post-installed anchors.
 - 7. Handrail brackets.
 - 8. Shop primer.
 - 9. Intermediate coats and topcoats.
 - 10. Bituminous paint.
 - 11. Nonshrink, nonmetallic grout.
 - 12. Anchoring cement.
 - 13. Metal finishes.

14. Paint products.

- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Initial Selection: For products involving selection of color, texture, or design.
- D. Samples for Verification: For each type of exposed finish required.
 - 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters, including finish.
 - 2. Fittings and brackets.
 - 3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
 - a. Show method of connecting and finishing members at intersections.
- E. Delegated-Design Submittal: For railings, including analysis data and calculations signed and sealed by the qualified professional engineer, licensed in the State of Florida, responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For delegated-design professional engineer and testing agency.
- B. Welding certificates.
- C. Mill Certificates: Signed by manufacturers of stainless steel products, certifying that products furnished comply with requirements.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- E. Product Test Reports: For tests on railings performed by a qualified testing agency, in accordance with ASTM E894 and ASTM E935.
- F. Research Reports: For post-installed anchors, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces of railings from damage by applying a strippable, temporary protective covering before shipping.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.
- B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:
 - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
 - b. Infill load and other loads need not be assumed to act concurrently.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces].

2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
 - 1. Provide type of bracket with either flange tapped for concealed anchorage to threaded hanger bolt, or predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

2.3 STEEL RAILINGS

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. Tubing: ASTM A500 (cold formed) or ASTM A513, Type 5.
- C. Pipe: ASTM A53, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

1. Provide galvanized finish for exterior installations and where indicated.
- D. Plates, Shapes, and Bars: ASTM A36.
- E. Cast Iron Fittings: Either gray iron, ASTM A48, or malleable iron, ASTM A47, unless otherwise indicated.
- F. Expanded Metal Infill Panels: As indicated; however not less than ASTM F1267, Type I (expanded), or Type II (expanded and flattened), Class 1 (uncoated).
1. Style Designation: As indicated; however not less than 3/4 number 13, or 1-1/2 number 10.
- G. Perforated-Metal Infill Panels:
1. Cold-Rolled Steel Sheet: ASTM A1008, or hot-rolled steel sheet, ASTM A1011, commercial steel, Type B, as indicated; however not less than 0.060 inch thick, with 1/4-inch (6.4-mm) holes 3/8 inch (9.5 mm) o.c. in staggered rows.
 - a. Basis-of-Design Product: Provide product with perforations matching product indicated on Drawings].
 2. Galvanized-Steel Sheet, ASTM A653, G90 coating, commercial steel Type B, as indicated; however not less than 0.064 inch thick, with 1/4-inch (6.4-mm) holes 3/8 inch (9.5 mm) o.c. in staggered rows.
 - a. Basis-of-Design Product: Provide product with perforations matching product indicated on Drawings.
- H. Woven-Wire Mesh Infill Panels: Intermediate-crimp, diamond pattern, 2-inch woven-wire mesh, made from 0.134-inch-diameter steel wire complying with ASTM A510.
1. Basis-of-Design Product: Provide product with crimp pattern matching product indicated on Drawings.

2.4 ALUMINUM RAILINGS

- A. Source Limitations: Obtain Obtain each type of railing from single source from single manufacturer.
- B. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.
- C. Extruded Bars and Tubing: ASTM B221, Alloy 6063-T5/T52.
- D. Extruded Structural Pipe and Round Tubing: ASTM B429, Alloy 6063-T6.
1. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.
- E. Drawn Seamless Tubing: ASTM B210, Alloy 6063-T832.
- F. Plate and Sheet: ASTM B209, Alloy 6061-T6.
- G. Die and Hand Forgings: ASTM B247, Alloy 6061-T6.

- H. Castings: ASTM B26, Alloy A356.0-T6.
- I. Perforated Metal Infill Panels: Aluminum sheet, ASTM B209, Alloy 6061-T6, 0.063 inch thick, with 1/4-inch holes 3/8 inch o.c. in staggered rows.
 - 1. Basis-of-Design Product: Provide product with perforations matching product indicated on Drawings.
- J. Woven-Wire Mesh Infill Panels: Intermediate-crimp, diamond pattern, 2-inch woven-wire mesh, made from 0.162-inch-diameter aluminum wire complying with ASTM B211/B211M, Alloy 6061-T94.
 - 1. Basis-of-Design Product: Provide product with crimp pattern matching product indicated on Drawings.

2.5 STAINLESS STEEL RAILINGS

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. Tubing: ASTM A554, Grade MT 304.
- C. Pipe: ASTM A312, Grade TP 304.
- D. Castings: ASTM A743, either Grade CF 8 or CF 20, or Grade CF 8M or CF 3M.
- E. Plate and Sheet: ASTM A240 or ASTM A666, Type 304.
- F. Expanded Metal Infill Panels: ASTM F1267, either Type I (expanded), or Type II (expanded and flattened), Class 3 (corrosion-resistant steel), made from stainless steel sheet, ASTM A240 or ASTM A666, Type 304.
 - 1. Style Designation: either 3/4 number 13, or 1-1/2 number 10.
- G. Perforated Metal Infill Panels: Stainless steel sheet, ASTM A240 or ASTM A666, Type 304, as indicated; however not less than 0.062 inch thick, with 1/4-inch (6.4-mm) holes 3/8 inch (9.5 mm) o.c. in staggered rows.
 - 1. Basis-of-Design Product: Provide product with perforations matching product indicated on Drawings.
- H. Woven-Wire Mesh Infill Panels: Intermediate-crimp, diamond pattern, 2-inch woven-wire mesh, made from 0.141-inch-diameter stainless steel wire complying with ASTM A580, Type 304.
 - 1. Basis-of-Design Product: Provide product with crimp pattern matching product indicated on Drawings.

2.6 FASTENERS

- A. Fastener Materials:
 - 1. Ungalvanized-Steel Railing Components: Plated steel fasteners complying with ASTM F1941, Class Fe/Zn 5 for zinc coating.
 - 2. Hot-Dip Galvanized Railing Components: Type 304 stainless steel or hot-dip zinc-coated steel fasteners complying with ASTM A153 or ASTM F2329 for zinc coating.

3. Aluminum Railing Components: Type 304 stainless steel fasteners.
 4. Stainless Steel Railing Components: Type 304 stainless steel fasteners.
 5. Finish exposed fasteners to match appearance, including color and texture, of railings.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction and capable of withstanding design loads.
- C. Fasteners for Interconnecting Railing Components:
1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
 2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
 3. Provide square or hex socket flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.
1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

2.7 MISCELLANEOUS MATERIALS

- A. Handrail Brackets: Unless otherwise indicated, provide Cast nickel-silver, center of handrail 3-1/8 inches from face of railing or wall.
- B. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for metal alloy welded.
1. For aluminum and stainless steel railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- C. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint, complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting", Section 099123 "Interior Painting, " or Section 099600 "High-Performance Coatings."
- F. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- G. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

- H. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- I. Intermediate Coats and Topcoats: Provide products that comply with Section 099113 "Exterior Painting," Section 099123 "Interior Painting," or Section 099600 "High-Performance Coatings."
- J. Epoxy Intermediate Coat: Complying with MPI #77 and compatible with primer and topcoat.
- K. Polyurethane Topcoat: Complying with MPI #72 and compatible with undercoat.
- L. Bituminous Paint: Cold-applied asphalt emulsion, complying with ASTM D1187.
- M. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout, complying with ASTM C1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- N. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 - 1. Water-Resistant Product: At exterior locations and where indicated on Drawings, provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.8 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.
 - 1. Clearly mark units for reassembly and coordinated installation.
 - 2. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately.
 - 1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
 - 2. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that are exposed to weather in a manner that excludes water.
 - 1. Provide weep holes where water may accumulate.
 - 2. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded or nonwelded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

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 flux immediately.
 4. At exposed connections, unless otherwise indicated finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #2 welds; good appearance, completely sanded joint, some undercutting and pinholes okay.
- I. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- J. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
1. Fabricate splice joints for field connection, using an epoxy structural adhesive, if this is manufacturer's standard splicing method.
- K. Form changes in direction as detailed.
- L. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- M. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.
- N. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- O. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- P. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work.
1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
 2. Coordinate anchorage devices with supporting structure.
- Q. For railing posts set in concrete, provide stainless steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.
- R. For removable railing posts, fabricate slip-fit sockets from stainless steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height.
1. Provide socket covers designed and fabricated to resist being dislodged.
 2. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.

- S. Expanded-Metal Infill Panels: Fabricate infill panels from expanded-metal sheet of same metal as railings.
 - 1. Edge panels with U-shaped channels made from metal sheet, of same metal as expanded metal and not less than 0.043 inch thick.
 - 2. Orient expanded metal with long dimension of diamonds parallel to top rail, unless otherwise indicated.
- T. Perforated-Metal Infill Panels: Fabricate infill panels from perforated metal made from same metal as railings in which they are installed.
 - 1. Edge panels with U-shaped channels made from metal sheet, of same metal as perforated metal and not less than 0.043 inch thick.
 - 2. Orient perforated metal with pattern as indicated on Drawings.
- U. Woven-Wire Mesh Infill Panels: Fabricate infill panels from woven-wire mesh crimped into 1-by-1/2-by-1/8-inch metal channel frames.
 - 1. Fabricate wire mesh and frames from same metal as railings in which they are installed.
 - 2. Orient wire mesh with as indicated on Drawings.
- V. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.9 STEEL AND IRON FINISHES

- A. Galvanized Railings:
 - 1. Hot-dip galvanize indicated steel railings, including hardware, after fabrication.
 - 2. Comply with ASTM A123 for hot-dip galvanized railings.
 - 3. Comply with ASTM A153 for hot-dip galvanized hardware.
 - 4. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
 - 5. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner and as follows.
 - 1. Comply with SSPC-SP 16.
- D. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, hot-dip galvanize anchors to be embedded in exterior concrete or masonry.
- E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below:
 - 1. Exterior Railings: SSPC-SP 6/NACE No. 3.
 - 2. Railings Indicated To Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3.
 - 3. Railings Indicated To Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3.
 - 4. Other Railings: SSPC-SP 3.

- F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1 for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
 - 1. Shop prime uncoated railings with zinc-rich primer unless otherwise indicated.
 - 2. Do not apply primer to galvanized surfaces.
- G. Shop-Painted Finish: Comply with Section 099113 "Exterior Painting" and Section 099600 "High-Performance Coatings."
 - 1. Color: Match Architect's sample unless otherwise indicated.
- H. High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1 for shop painting. Apply at spreading rates recommended by coating manufacturer.
 - 1. Color: Match Architect's sample unless otherwise indicated.

2.10 ALUMINUM FINISHES

- A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Mill Finish: AA-M12, nonspecular as fabricated.
- C. Clear Anodic Finish: AAMA 611, AA-M12C22A41, or AA-M12C22A31.
- D. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, or AA-M12C22A32/A34.
 - 1. Color: Match Architect's sample unless otherwise indicated.
- E. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Color and Gloss: Match Architect's sample unless otherwise indicated.
- F. High-Performance Organic Finish, Two-Coat Polyvinylidene Fluoride (PVDF): Fluoropolymer finish complying with either AAMA 2604 or AAMA 2605 and containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: Match Architect's sample unless otherwise indicated.
- G. Superior Performance Organic Finish, Three-Coat Polyvinylidene Fluoride (PVDF): Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: Match Architect's sample unless otherwise indicated.

- H. Superior Performance Organic Finish, Four-Coat Polyvinylidene Fluoride (PVDF): Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: Match Architect's sample unless otherwise indicated.
- I. Single-Coat Superior Performance FEVE Organic Finish: Single-coat fluoroethylene vinyl ether (FEVE) fluoropolymer finish, complying with AAMA 2605. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: Match Architect's sample unless otherwise indicated.
- J. Two-Coat Superior Performance FEVE Organic Finish: Two-coat fluoroethylene vinyl ether (FEVE) fluoropolymer finish complying with AAMA 2605. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.
 - 1. Color and Gloss: Match Architect's sample unless otherwise indicated.

2.11 STAINLESS STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain with long dimension of each piece.
 - 2. When polishing is completed, passivate and rinse surfaces.
 - 3. Remove embedded foreign matter and leave surfaces chemically clean.
- C. Stainless Steel Pipe and Tubing Finishes:
 - 1. 180-Grit Polished Finish: Uniform, directionally textured finish.
 - 2. 320-Grit Polished Finish: Oil-ground, uniform, fine, directionally textured finish.
 - 3. Polished and Buffed Finish: 320-grit finish followed by buffing to match Architect's sample unless otherwise indicated.
- D. Stainless Steel Sheet and Plate Finishes:
 - 1. Directional Satin Finish: ASTM A480/A480, No. 4.
 - 2. High-Luster Finish: ASTM A480/A480M, No. 7.
 - 3. Mirror Finish: ASTM A480/A480M, No. 8.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

- A. Perform cutting, drilling, and fitting required for installing railings.
 - 1. Fit exposed connections together to form tight, hairline joints.
 - 2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
 - 3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
 - 4. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 5. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
 - 6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
 - 1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- C. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws, using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article, whether welding is performed in the shop or in the field.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve, extending 2 inches beyond joint on either side; fasten internal sleeve securely to one side; and locate joint within 6 inches of post.

3.4 ANCHORING POSTS

- A. Use stainless steel pipe sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- C. Cover anchorage joint with flange of same metal as post, attached to post with setscrews, unless otherwise indicated.

- D. Leave anchorage joint exposed with 1/8-inch buildup, sloped away from post, unless otherwise indicated.
- E. Anchor posts to metal surfaces with flanges, angle type, or floor type, as required by conditions, connected to posts and to metal supporting members as follows:
 - 1. For steel railings, weld flanges to post and bolt to metal supporting surfaces.
 - 2. For aluminum railings, attach posts as indicated, using fittings designed and engineered for this purpose.
 - 3. For stainless steel railings, weld flanges to post and bolt to supporting surfaces.
- F. Install removable railing sections, where indicated, in slip-fit stainless steel sockets cast in concrete.

3.5 ATTACHING RAILINGS

- A. Anchor railing ends to concrete and masonry with sleeves concealed within railing ends and anchored to wall construction with anchors and bolts, unless otherwise indicated.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and connected to railing ends, using nonwelded connections (unless otherwise indicated).
- C. Attach handrails to walls with wall brackets, unless otherwise indicated. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface, unless otherwise indicated.
 - 1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt, unless otherwise indicated.
 - 2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- D. Secure wall brackets to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.
 - 3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
 - 4. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.
 - 5. For steel-framed partitions, fasten brackets directly to steel framing or concealed steel reinforcements, using self-tapping screws of size and type required to support structural loads.
 - 6. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.6 REPAIR

- A. Touchup Painting:
 - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting," Section 099123 "Interior Painting," or Section 099600 "High-Performance Coatings."

3.7 CLEANING

- A. Clean aluminum and stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A780.

3.8 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period, so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 05 52 13

DIVISION 06

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes rough carpentry for:
 - 1. Wood grounds, nailers, and blocking.
 - 2. Decay and termite resistant wood treatment.
- B. Related Sections include the following:
 - 1. Division 5 Section "Metal Decking" for pressure treated nailers for roofing.
 - 2. Division 6 Section "Finish Carpentry" for finish carpentry.
 - 3. Division 7 Section "Standing Seam Metal Roof Panels" for nailers and blocking for metal roofing.
 - 4. Division 7 Section "Flashing and Sheet Metal" for backing nailers and blocking for sheet metal.

1.02 QUALITY ASSURANCE

- A. Reference Standards: Comply with provisions of the following, unless otherwise indicated or specified:
 - 1. American Forest & Paper Association (AFPA):
 - a. Manual for Wood Frame Construction.
 - 2. American Lumber Standards Committee (ALSC):
 - a. Board of Review.
 - 3. APA - The Engineered Wood Association (APA):
 - a. APA Standard Grading Rules.
 - b. Form No. E30K - APA Design/Construction Guide: Residential & Commercial.
 - 4. American Society for Testing and Materials (ASTM):
 - a. Reference Standards.
 - 5. American Wood Preservers' Association (AWPA):
 - a. Reference Standards.
 - 6. Federal Specifications (FS):
 - a. Reference Standards.

7. U.S. Department of Commerce (DOC), National Institute of Standards and Technology:
 - a. Referenced Product Standards (PS).
8. Southern Pine Inspection Bureau (SPIB):
 - a. SPIB Standard Grading Rules.
9. West Coast Lumber Inspection Bureau (WCLIB):
 - a. WCLIB Standard Grading Rules.
10. Western Wood Products Association (WWPA):
 - a. WWPA Standard Grading Rules.
 - b. Recommended Nailing Schedule.

1.03 SUBMITTALS

- A. Product Data for Treated Lumber: Submit treatment plant's data showing the lumber type, certification by the treating plant stating chemicals and process used, net amount of treatment retained, and conformance with applicable standards. Include a statement that moisture content of treated materials was reduced to a maximum of 19 percent prior to shipment to the Site.
- B. Calculations: Provide calculations for the type, size, length and minimum embedment depth of fasteners required for wood furring and plywood walls used to support the wall mounted equipment. Calculations shall be signed and sealed by a professional engineer currently registered in the State of Florida.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Maintain materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber as well as plywood and other panels; provide for air circulation within and around stacks and under temporary coverings including polyethylene and similar materials.
- B. For lumber and plywood pressure treated with waterborne chemicals, provide space between each course to provide air circulation.

1.05 PROJECT CONDITIONS

- A. Coordination: Fit carpentry work to other work; scribe and cope as required for accurate fit. Correlate location of furring, nailers, plates, blocking, grounds and similar supports to allow attachment of other work.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Lumber Standards, General:
 1. Manufacture lumber to comply with DOC PS 20 "American Softwood Lumber Standard" and with applicable grading rules of inspection agencies certified by ALSC Board of Review.

2. Factory mark each piece of lumber with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade species, moisture content at time of surfacing, and mill.
 3. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by DOC PS 20, for moisture content specified for each use.
 4. Provide seasoned lumber with 19 percent maximum moisture content at time of dressing and shipment for sizes 2 inches or less in nominal thickness, unless otherwise indicated.
- B. Grounds, Blocking, Nailers, Blocking, and Similar Members:
1. Grounds, nailers, blocking, and similar members shall be standard grade light framing size lumber of any species or board size lumber as required. No. 2 Common or Standard grade boards per WCLIB or WWPA rules, or No. 2 boards per SPIB rules.
- C. Plywood Panels:
1. Comply with DOC PS 1 "U.S. Product Standard for Construction and Industrial Plywood" for plywood panels and, for products not manufactured under PS 1 provisions, with APA Form No. E30K.
 2. Factory mark each construction panel with APA trademark evidencing compliance with grade requirements.
- D. Fasteners and Anchorages:
1. Provide size, type, material, and finish as indicated and as recommended by applicable standards, complying with applicable Federal Specifications for nails, staples, screws, bolts, nuts, washers, and anchoring devices. Provide metal hangers and framing anchors of the size and type recommended by the manufacturer for each use including recommended nails.
 2. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners and anchorages with a hot-dip zinc coating pursuant to ASTM A 153.
- E. Decay and Termite Resistant Wood Treatment:
1. All lumber and plywood specified for decay and termite resistant treatment shall be pressure treated according to AWPAs Standard P-5 and FS TT-W-550. Preservatives containing arsenic are NOT acceptable.
 2. Products: Provide one of the following treatments:
 - a. "Natural Select" copper azole preservative; Arch Wood Protection, Inc.
 - b. "Preserve" ACQ; Chemical Specialties, Inc.
 - c. "NatureWood"; Osmose, Inc.

2.02 WOOD TREATMENT

- A. Decay and Termite Resistant Wood Treatment: Chemicals shall be applied in a closed cylinder by vacuum-pressure process in strict accordance with manufacturer's instructions and with the approved standards and recommended treating practices as listed in AWPAs Standards C2 and C9

or the appropriate AWP standard covering the commodity treated and as listed in FS TT-W-571.

1. After treatment and before shipment, lumber 2" nominal or less shall be dried to a 15-19 percent moisture content.
2. Plywood shall be dried after treatment and before shipment to moisture content of 18 percent or less.
3. Surfaces of wood that are to be exposed or painted shall be free from sludge or deposits of salts that would affect its paintability.

B. Provide decay (termite) treatment of the following lumber:

<u>Location</u>	<u>Treatment (General)</u>
Wood members and plywood panels in contact with concrete, used in connection with roofing, or exposed to moisture	Decay (Termite)

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine the areas and conditions under which rough carpentry work is to be installed. Do not proceed with rough carpentry work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General:

1. Material with defects, which might impair the quality of the work, and units which are too small to fabricate with a minimum of joints or the optimum joint arrangement, shall be discarded.
2. All rough carpentry work shall be set accurately to required levels and lines, with members plumb and true, and accurately cut and fitted.
3. All rough carpentry work shall be securely attached to substrates by anchoring and fastening as shown, and as required for structural adequacy.
4. Fasteners shall be of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Tight connections shall be made. Fasteners shall be installed without splitting of wood; predrill as required.
5. Use washers where required for fasteners to avoid movement of material through loading and/or vibration.
6. Seal cut ends where exposed to moisture or where moisture could migrate via gravity, capillary action, expansion or pressure gradients.

B. Wood Grounds, Nailers, and Blocking:

1. Wood grounds, nailers, and blocking shall be installed where indicated on the Drawings, and wherever required for screeding or attachment of other work. Shapes shall be formed as shown and cut as required for true line and level of work to be attached.

2. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork prior to concrete placement.

C. Plywood Panels:

1. Comply with applicable recommendations contained in APA Form No. E 30K for types of plywood panels and applications indicated.
2. Fastening Methods: Fasten panels as follows, in strict accordance with the Florida Building Code:
 - a. Backing Panels: Nail and/or screw to supports, as applicable.

END OF SECTION 06 10 00

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DIVISION 07

SECTION 07 13 20 - SELF-ADHERING SHEET UNDERLAYMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes:
 - 1. Self-adhering sheet underlayment for standing seam metal roof panels as indicated on the Drawings.
- B. Related Sections include the following:
 - 1. Division 6 Section "Rough Carpentry" for pressure treated wood nailers, blocking, and sheathing required for roofing work.
 - 2. Division 7 Section "Roof and Deck Insulation" for composite insulation system for metal roofing.
 - 3. Division 7 Section "Standing Seam Metal Roof Panels" for metal roof panels and related attachments.
 - 4. Division 7 Section "Flashing and Sheet Metal" for sheet metal flashing, coping, and sheet metal closures for roofing work.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For the following products, of sizes indicated, to verify color selected.
 - 1. Self-Adhering Underlayment: 12 inches square.

1.03 QUALITY ASSURANCE

- A. Source Limitations: Obtain self-adhering sheet underlayment through one source from a single underlayment manufacturer.
- B. Fire-Test-Response Classification: Provide underlayment with the fire-test-response characteristics indicated, as determined by testing identical products per test method below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Exterior Fire-Test Exposure: Class A; ASTM E 108, or UL 790, for application and roof slopes indicated.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store underlayment rolls on end on pallets or other raised surfaces. Do not double-stack rolls.
 - 1. Handle, store, and place materials in a manner to avoid significant or permanent damage to roof deck or structural supporting members.
- B. Protect unused underlayment from weather, sunlight, and moisture when left overnight or when roofing work is not in progress.

1.05 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit underlayment work to be performed according to manufacturer's written instructions and warranty requirements.
 - 1. Install self-adhering sheet underlayment within the range of ambient and substrate temperatures recommended by manufacturer.

PART 2 - PRODUCTS

2.01 UNDERLAYMENT MATERIALS

- A. Self-Adhering Sheet Underlayment, Polyethylene Faced: ASTM D 1970, minimum of 40 mil thick, slip-resisting, polyethylene-film-reinforced top surface laminated to SBS-modified asphalt adhesive, with release paper backing; cold applied. Provide primer for adjoining concrete or masonry surfaces to receive underlayment.
 - 1. Basis of Design: "Grace Ice and Water Shield"; W.R. Grace & Co., or approved equal.
 - 2. Membrane Thickness: 40 mils per ASTM D3767 Method A.
 - 3. Membrane Tensile Strength: 250 psi ASTM D412 Die C modified.
 - 4. Membrane Elongation: 250% per ASTM D412 Die C Modified.
 - 5. Maximum Permeance: 0.05 perms per ASTM E96.
- B. Code and Standard Compliance:
 - 1. ASTM D1970.
 - 2. ICC-ES ESR-3121, per AC 48 Acceptance Criteria for Roof Underlayments.
 - 3. Florida State Approval Report No. FL298-R7

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of Work.
 - 1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 UNDERLAYMENT INSTALLATION

- A. Install self-adhering sheet underlayment in accordance with manufacturer's written instructions. Install at locations indicated on Drawings, lapped in direction to shed water. Lap sides not less than 3-1/2 inches. Lap ends not less than 6 inches staggered 24 inches between courses. Roll laps with roller. Cover underlayment within seven days.

1. Prime concrete and masonry surfaces (if occurring) to receive self-adhering sheet underlayment.
2. Remove dust, dirt, loose materials and protrusions from deck surface.

END OF SECTION 07 13 20

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SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes:
 - 1. Rigid board insulation and Z furring on interior face of exterior walls.
 - 2. Mineral-wool blanket insulation.
- B. Related Sections include the following:
 - 1. Division 4 Section "Unit Masonry" for masonry wall construction.
 - 2. Division 7 Section "Roof and Deck Insulation" for composite insulation system for metal roofing.
 - 3. Division 9 Section "Gypsum Wallboard" for installation in metal framed assemblies of insulation.

1.02 SUBMITTALS

- A. Submit samples and product data for each type of insulation.

1.03 PRODUCT HANDLING, DELIVERY, AND STORAGE

- A. Deliver products in unopened containers. Provide adequate storage.
- B. Deliver materials to the job site in original unopened packages, clearly marked with product brand name and manufacture's labels. Store under cover and protect from weather and construction activities.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Rigid Insulation and Z Furring System:
 - 1. Rigid Insulation:
 - a. Polyisocyanurate Board Insulation: ASTM C 1289, Type I, Class 1 or 2, foil faced, with maximum flame-spread and smoke-developed indices of 75 and 450, respectively. Provide thickness to achieve "R" value indicated on Drawings.

- b. Basis of Design: Dow Chemical Company or approved equal by Atlas Roofing Corporation or Rmax, Inc.
 - 3. Z-Furring:
 - a. Basis of Design: ClarkDietrich Drywall Z-Furring Channels, 3" depth x 20 Gauge DW, or approved equal.
- B. Faced Mineral-Wool Blanket Insulation:
 - 1. Unfaced, Mineral-Wool Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
 - 2. Reinforced-Foil-Faced, Mineral-Wool Blanket Insulation: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less per ASTM E 84); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.
 - a. Products: Provide insulation products by one of the following manufacturers:
 - 1) Thermafiber.
 - 2) Rockwool.
 - 3) Owens Corning.
 - 4) Or Approved Equal
 - b. Thickness: As indicated on the Drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install insulation in strict accordance with manufacturer's published instructions.

END OF SECTION 07 21 00

SECTION 07 22 00 - ROOF AND DECK INSULATION

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes:
 - 1. Rigid polyisocyanurate roof and deck insulation faced with GFR or CGF facer on both major surfaces of the core foam for standing seam metal roof panels as indicated on the Drawings.
- B. Related Sections include the following:
 - 1. Division 6 Section "Rough Carpentry" for pressure treated wood nailers, blocking, and sheathing required for roofing work.
 - 2. Division 7 Section "Self-Adhering Sheet Underlayment" for underlayment sheet for metal roofing.
 - 3. Division 7 Section "Standing Seam Metal Roof Panels" for metal roof panels.
 - 4. Division 7 Section "Flashing and Sheet Metal" for sheet metal flashing, coping, and sheet metal closures for roofing work.

1.02 SUBMITTALS

- A. Product Data: Manufacturer's specifications, installation instructions, and product data sheets for insulation board and related accessories.
- B. Shop Drawings: Roof plan showing layout of boards and fastening patterns.
- C. Samples: 6" x 6" of proposed board and related fasteners.
- D. Sample warranty indicating conditions and limitations.

1.03 CODE/STANDARD COMPLIANCE

- A. Product Compliance: The roof and deck insulation shall have a State of Florida Product Control Notice of Acceptance (NOA) and meet all requirements of the Florida Product Approval System as required by Florida Statute 553.842 and Florida Administrative Code 9B-72.
- B. UL Class A Roof System requirements and FMG Class I Roof System for designated wind load per FMG Loss Prevention Data Sheet 1-28, "Wind Loads to Roof Systems and Roof Deck Securement."
- C. Comply with the following testing procedures:
 - 1. Florida Building Code Test Protocol TAS 105-Test Procedure for Field Withdrawal Resistance Testing.
 - 2. Florida Building Code Test Protocol TAS 114-Test Procedures for Roof System as the High Velocity Hurricane Zone Jurisdiction.
 - a. Appendix A- Test Procedure for Above Deck Combustibility ASTM E 108.

- b. Appendix C-Test Procedure for Simulated Uplift Pressure Resistance of Roof System Assemblies.
- 3. ASTM C1289: Standard Specification for Faced Rigid Cellular Polyisocyanurate Insulation Board.
- 4. FM 4450: Approval Standard – Class I Insulated Steel Roof Decks
- 5. FM 4470: Approval Standard – Class I Roof Covers.
- 6. FM 4473: Specification Test Standard for Impact Resistance of Rigid Roofing Materials.

1.04 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Company specializing in manufacturing products specified in this Section with minimum 10-years documented experience.
- B. Installer Qualifications: Company specializing in the installation of products specified in this Section with minimum 5-years documented experience using products of same type and scope as used for this Project.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in packages labeled with material name, thermal value and product code.
- B. When stored outdoors or on the Project site, insulation shall be stacked on pallets at least 3-inches above ground level and completely covered with a waterproof covering. The temporary factory-applied packaging shall be slit or removed to prevent accumulation of condensation. Insulation which has become wet or damaged shall be removed and replaced with solid, dry insulation.

1.06 PROJECT CONDITIONS

- A. Sequencing: Coordinate with metal roofing installer and roof and deck insulation manufacturer's installation instructions.
- B. Maintain environmental conditions (temperature, humidity and ventilation) within limits recommended by roof and deck insulation manufacturer for optimum results. Do not install products under environmental conditions outside roof and deck insulation manufacturer's limits.

PART 2 - PRODUCTS

2.01 ROOF AND DECK INSULATION

- A. Basis of Design: AC Foam®-III CGF Roof Insulation as manufactured by Atlas Roofing Corporation, or approved equal. Flat closed-cell polyisocyanurate (polyiso) foam core integrally bonded to inorganic coated glass facers.
- B. Roof and deck insulation shall be constructed as follows:
 - 1. Panel Area (Size): 4-foot x 8-foot.
 - 2. Polyisocyanurate Insulation, thickness as required to achieve R value of R-30 minimum.

3. GRF or CGF facer.
- C. Roof and deck insulation shall conform to the following:
1. ASTM C 1289, Type II.
 2. UL Standard 1256 Classification; Construction No. 120, 123 and 292.
 3. UL Standard 790 (ASTM E 108): For use with Class A, B or C Shingles, Metal or Tile Roof Coverings.
 4. FM Standard 4450 & 4470 Approved (1-90, 1-105); Approved for Class 1 Insulated Roof Deck Construction.
 5. State of Florida Product Approval: FL17989.
 6. Dimensional Stability: ASTM D 2126: <2%.
 7. Compressive Strength: ASTM D 1621: 25 psi.
 8. Water Absorption: ASTM C 209 (<1.5%).
 9. Water Vapor Transmission: ASTM E96: <4.0 perm.
 10. Product Density: ASTM D 1622: Nominal 2.0 pcf.
 11. Flame Spread: ASTM E 84 10 min.: 40-60.
 12. Smoke Developed: ASTM E 84 10 min.: 50-170.
 13. Tensile Strength: ASTM D 1623: 730 psf.
 14. Service Temperature: -100-degrees F to +250-degrees F.
- D. Coverboard:
1. Basis Design: DensDeck Roof Board as manufactured by GAF or approved equal.
 2. Coverboard shall conform to the following:
 - a. Thickness: 5/8" 4' x 8' Board
 - b. Compressive Strength: 900 psi.
 - c. Flame Spread, Smoke Developed: ASTM E 84, UL 723: 0-0
 - d. Water Absorption: ASTM C1177: <2.5%.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine metal roof deck substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of Work.
1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely

anchored.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install roof and deck insulation in accordance with manufacturer's written instructions. Use approved mechanical fasteners as required by governing code requirements.
- B. Install with end joints staggered to avoid having insulation joints coinciding with joints in deck.

3.03 PROTECTION

- A. Remove trash and construction debris from insulation surface prior to application of roofing membrane.
- B. Do not leave installed insulation exposed to weather. Cover and waterproof completed roof system immediately after installation.
 - 1. Temporarily seal exposed insulation edges at the end of each work day.
 - 2. Remove and replace installed insulation that has become wet or damaged with new insulation.

END OF SECTION 07 22 00

SECTION 07 26 16 – UNDER-SLAB VAPOR BARRIER

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes:
 - 1. Under-slab vapor barrier located under all concrete floor slabs, including walks within building line, as indicated on the Drawings and specified herein.
- B. Related Sections include the following:
 - 1. Division 3 Section “Cast-In-Place Concrete” for concrete work.
 - 2. Division 31 Section “Earthwork” for subgrade and compaction.
 - 3. Division 31 Section “Termite Treatment” for subterranean termite control.

1.02 SUBMITTALS

- A. Product Data: Submit manufacturer's published descriptive literature, including typical details and installation instructions, for vapor barrier membrane, mastic, and tape.
- B. Samples: Submit three (3) 12-inch by 12-inch samples of vapor barrier membrane and 6 inch length samples of tape.

1.03 DELIVERY AND STORAGE

- A. Packaged Materials: Deliver materials in bundles, rolls, and sealed containers bearing the manufacturer's original labels. Store materials in an enclosed area free from contact with soil and weather, and maintain at not less than 50 degrees F for at least 24 hours before use. If material is dated for use or “shelf life” is indicated on the labels, all outdated material shall be removed from the Site.

PART 2 - PRODUCTS

2.01 VAPOR BARRIER MATERIALS

- A. Vapor Barrier Membrane: Comply with the following:
 - 1. Membrane Material: Flexible plastic or plastic laminate membrane, minimum 15.0 mils in thickness.
 - 2. Products: Provide one of the following vapor barrier membranes:
 - a. Stego Industries, LLC.
 - b. “Nervastral”; Nervastral, Inc.
 - c. “Fiberweb 210 Underslab Vapor Barrier”; Fiberweb Division of Hammerbeam, Inc.
 - d. “Moistop Underslab”; Fortiber Building Products.
 - e. “Griffolyn Type 65G”; Reef Industries.
- B. Mastic: Comply with the following:

1. Provide mastic compound as recommended by the membrane manufacturer.
- C. Tape: Double-sided pressure sensitive tape with release paper. Suitable as a durable field seam around penetrations in the vapor barrier membrane and to join membrane sheets together

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine the areas and conditions under which the under-slab vapor barrier is to be installed. Do not proceed with vapor barrier work until unsatisfactory conditions have been corrected.

3.02 APPLICATION

- A. Apply directly to compacted earth base, under concrete slabs, one layer of the vapor barrier membrane. Maintain 6-inch side laps and 9-inch end laps; turn down membrane 12 inches at slab/wall intersections.
- B. Laps shall be fully sealed with mastic in strict accordance with manufacturer's published instructions for application procedures and limitations for temperature and setting time.
- C. Additional strips shall be used at penetrations of membrane to close openings in membrane. Set in mastic.
- D. Extreme care and precaution shall be exercised after membrane has been applied to prevent punctures, tears, and other abuses. Should such vapor barrier damage occur, repair the membrane by application of a membrane patch, sized to lap 9-inches on all sides of the damaged area, and set in a full bed of mastic.

END OF SECTION 07 26 16

SECTION 07 41 13 - STANDING SEAM METAL ROOF PANELS

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes:
 - 1. Standing seam metal roof panels and related attachments/accessories as indicated on Drawings and specified herein.
- B. Related Sections include the following:
 - 1. Division 6 Section "Rough Carpentry" for pressure treated wood nailers, blocking, and sheathing required for roofing work.
 - 2. Division 7 Section "Flashing and Sheet Metal" for sheet metal flashing, coping, and sheet metal closures for roofing work.
 - 3. Division 7 Section "Roof Accessories" for roof curbs, equipment supports and expansions joint assemblies.
 - 4. Division 7 Section "Joint Sealants" for sealing joints.

1.02 PERFORMANCE REQUIREMENTS

- A. General: Provide metal roof panel assemblies that comply with performance requirements specified as determined by testing manufacturers' standard assemblies similar to those indicated for this Project, by a qualified testing and inspecting agency.
- B. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of roof area when tested according to ASTM E 1680 at the following test-pressure difference:
 - 1. Test-Pressure Difference: Positive and negative 1.57 lbf/sq. ft.
 - 2. Positive Preload Test-Pressure Difference: Greater than or equal to 15.0 lbf/sq. ft. and the greater of 75 percent of building live load or 50 percent of building design positive wind-pressure difference.
 - 3. Negative Preload Test-Pressure Difference: 50 percent of design wind-uplift-pressure difference
- C. Water Penetration: No water penetration when tested according to ASTM E 1646 at the following test-pressure difference:
 - 1. Test-Pressure Difference; 20 percent of positive design wind pressure, but not less than 6.24 lbf/sq. ft. and not more than 120.0 lbf/sq. ft.
 - 2. Positive Preload Test-Pressure Difference: Greater than or equal to 15.0 lbf/sq. ft. and the greater of 75 percent of building live load or 50 percent of building design positive wind-pressure difference.
 - 3. Negative Preload Test-Pressure Difference: 50 percent of design wind-uplift-pressure difference.

- F. Thermal Movements: Provide metal roof panel assemblies that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.03 CODE/STANDARD COMPLIANCE

- A. Product Compliance: The roofing system shall have a State of Florida Product Control Notice of Acceptance (NOA) and meet all requirements of the Florida Product Approval System as required by Florida Statute 553.842 and Florida Administrative Code 9B-72.
- B. UL Class A Roof System requirements and FMG Class I Roof System for designated wind load per FMG Loss Prevention Data Sheet 1-28, "Wind Loads to Roof Systems and Roof Deck Securement."
- C. Provide roof covering materials bearing UL Classification Marking on bundle, package and/or container indicating that materials have been produced under UL's Classification and Follow-up Service.
- D. Comply with the following testing procedures:
1. Florida Building Code Test Protocol TAS 105-Test Procedure for Field Withdrawal Resistance Testing.
 2. Florida Building Code Test Protocol TAS 114-Test Procedures for Roof System as the High Velocity Hurricane Zone Jurisdiction.
 - a. Appendix A- Test Procedure for Above Deck Combustibility ASTM E 108.
 - b. Appendix C-Test Procedure for Simulated Uplift Pressure Resistance of Roof System Assemblies.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
1. Installer's responsibilities include fabricating and installing metal roof panel assemblies and providing professional engineering services needed to assume engineering responsibility.
 2. Engineering Responsibility: Preparation of data for metal roof panels and accessories, including shop drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated, as documented according to ASTM E 548.
- C. Source Limitations: Obtain each type of metal roof panels through one source from a single manufacturer.
- D. Preinstallation Conference: Conduct conference at Project site. Review methods and procedures related to metal roof panel assemblies.

1. Meet with Owner, Architect/Engineer, testing and inspecting agency representative, metal roof panel Installer, metal roof panel manufacturer's representative, deck Installer, and installers whose work interfaces with or affects metal roof panels including installers of roof accessories.

1.05 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal roof panel and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of metal roof panels; details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and accessories; and special details. Distinguish between factory- and field-assembled work.
 1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:
 - a. Fascia, flashing and trim.
 - b. Gutters.
 - c. Downspouts.
 2. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified Professional Engineer currently registered in the State of Texas responsible for their preparation.
- C. Samples for Verification: For each type of exposed finish required, prepared on samples of size indicated below:
 1. Metal Roof Panels: 12 inches long by actual panel width. Include fasteners, clips, closures, and other metal roof panel accessories.
 2. Fascia, Trim and Closures: 12 inches long. Include fasteners and other exposed accessories.
 3. Accessories: 12 inch long samples for each type of accessory.
- D. Qualification Data: For Installer, professional engineer, and testing agency.
- E. Field quality control inspection reports.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for the following:
 1. Metal Roof Panels: Include reports for air infiltration, water penetration, and structural performance.
- G. Maintenance Data: For metal roof panels to include in maintenance manuals.
- H. Warranties: Special warranties specified in this Section.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, metal roof panels, and other manufactured items so as not to be damaged or deformed. Package metal roof panels for protection during transportation or handling.

- B. Unload, store, and erect metal roof panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal roof panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal roof panels to ensure dryness. Do not store metal roof panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Protect strippable protective covering on metal roof panels from exposure to sunlight and high humidity, except to extent necessary for period of metal roof panel installation.

1.07 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal roof panels to be performed according to manufacturers' written instruction and warranty requirements.
- B. Field Measurements: Verify locations of roof framing and roof opening dimensions by field measurements before metal roof panel fabrication and indicate measurements on shop drawings.

1.08 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal roof panel assemblies that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including rupturing, cracking, or puncturing.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal roof panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 35 years from date of Substantial Completion.
- C. Special Weathertightness Warranty for Metal Roof Panels: Manufacturer's standard form in which manufacturer agrees to repair or replace metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
 - 1. Warranty Period: 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PANEL MATERIALS

- A. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755.
 - 1. Aluminum-Zinc Alloy-Coated Steel Sheet: Galvalume® ASTM A 792, AZ-50 coating designation, Grade 40; structural quality.
 - 2. Profile/Surface/Color; Basis of Design: Berridge Zee-Lock Panel System, or approved equal, 16-inches wide, in color as indicated and/or as selected by Architect/Engineer and/or Owner.
 - 3. Exposed Finishes: Apply the following coating, as specified or indicated on Drawings:
 - a. High-Performance Organic Finish: AA-C12C42R1x. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - (1) Fluoropolymer Two-Coat or Three-Coat System (to meet warranty requirements): Manufacturer's standard thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.
 - 4. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.
- B. Provide full panels from ridge to eave with no horizontal joints.

2.02 MISCELLANEOUS MATERIALS

- A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal roof panels by means of plastic caps or factory-applied coating.
 - 1. Fasteners for Roof Panels: Self-drilling or self-tapping 410 stainless or zinc-alloy steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal roof panels.
 - 2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
 - 3. Blind Fasteners: High-strength stainless steel rivets.
- B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.03 ACCESSORIES

- A. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including trim, copings, fascias, corner units, ridge closures, clips, flashings, sealants, gaskets,

fillers, closure strips, and similar items. Match material and finish of metal roof panels, unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal roof panels.
 2. Clips: Minimum 0.0625 inch thick, stainless steel panel clips designed to withstand negative-load requirements.
 3. Cleats: Mechanically seamed cleats formed from minimum 0.0250 inch thick, stainless steel.
 4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 5. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1 inch thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- B. Flashing and Trim: Formed from 0.0179 inch thick, aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fascias, and fillers. Finish flashing and trim with same finish system as adjacent metal roof panels.
- C. Gutters: Formed from 0.0179 inch thick, aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96 inch long sections, sized according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced 36 inches o.c., fabricated from same metal as gutters. Provide bronze or copper wire ball strainers at outlets. Finish gutters to match metal roof panels.
- D. Downspouts: Formed from 0.0179 inch thick, aluminum-zinc alloy-coated steel sheet prepainted with coil coating; in 10 foot long sections, complete with formed elbows and offsets. Finish downspouts to match metal roof panels.

2.04 FABRICATION

- A. General: Fabricate and finish metal roof panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Provide panel profile for full length of panel.
- C. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.
1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 2. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.

3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
4. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal roof panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal roof panel manufacturer for application but not less than thickness of metal being secured.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of work.
- B. Examine roughing-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of metal roof panels before metal roof panel installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 METAL ROOF PANEL INSTALLATION, GENERAL

- A. General: Provide metal roof panels of full length from eave to ridge with no horizontal joints. Anchor metal roof panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 1. Field cutting of metal roof panels by torch is not permitted.
 2. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Predrill panels.
 3. Provide metal closures at peaks, rake edges, and each side of ridge and hip caps.
 4. Flash and seal metal roof panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
 5. Locate and space fastenings in uniform vertical and horizontal alignment to provide equal temperature movement.
 6. Install ridge and hip caps as metal roof panel work proceeds.
 7. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 8. Lap metal flashing over metal roof panels to allow moisture to run over and off the material.
- B. Fasteners:
 1. Roof Panels: Use stainless steel fasteners for surfaces exposed to the exterior and galvanized steel for surfaces exposed to the interior. Touch up exterior fasteners with

panel color.

- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
 - 1. Coat back side of steel roof panels with bituminous coating where roof panels will contact wood, ferrous metal, or cementitious construction.
- D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal roof panel assemblies. Provide types of gaskets, fillers, sealants indicated or, if not otherwise indicated, types recommended by metal roof panel manufacturer.
 - 1. Seal side joints as recommended by metal roof panel manufacturer.
 - 2. Prepare joints and apply sealants to comply with requirements of Section 07 92 00 – JOINT SEALANT.

3.03 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
- B. Fascia, Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 - 1. Install exposed fascia, flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal fascia, flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed fascia, flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- C. Touch up cut edges with manufacturer's matching color.

3.04 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal roof panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8 inch offset of adjoining faces and of alignment of matching profiles.

3.05 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect completed metal roof panel installation, including accessories. Report results in writing.
- B. Remove and replace applications of metal roof panels where inspections indicate that they do not comply with specified requirements.
- C. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.06 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.
- B. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 41 13

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SECTION 07 42 13 - FORMED METAL WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Concealed-fastener, lap-seam metal wall panels.
 - 2. Metal liner panels.
- B. Related Sections include the following:
 - 1. Division 5 Section "Cold-Formed Metal Framing" for cold-formed metal framing supporting metal panels.
 - 2. Division 7 Section "Flashing and Sheet Metal" for sheet metal flashing, coping, and sheet metal closures for roofing work.
 - 3. Division 7 Section "Joint Sealants" for sealing joints.

1.2 REFERENCES

- A. American Architectural Manufacturer's Association (AAMA):
 - 1. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems.
 - 2. AAMA 621 - Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) & Zinc-Aluminum Coated Steel Substrates.
- B. FM Global (FM):
 - 1. FM 4880 American National Standard for Evaluating Insulated Wall and Roof/Ceiling Assemblies
 - 2. FM 4881 Approval Standard for Class 1 Exterior Wall Systems.
- C. ASTM International (ASTM):
 - 1. ASTM A 653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 2. ASTM A 755 - Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Pre-painted by the Coil-Coating Process for Exterior Exposed Building Products.
 - 3. ASTM E 1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.

1.3 QUALITY ASSURANCE

- A. Manufacturer/Source: Provide metal panel assemblies and accessories from a single manufacturer approved under an accredited third-party quality control program.
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. **Preinstallation Meeting:** Prior to erection of framing, conduct preinstallation meeting at site attended by Owner, Architect, metal panel installer, metal panel manufacturer's technical representative, inspection agency and related trade contractors.
 - 1. Coordinate building framing in relation to metal panel system.
 - 2. Coordinate openings and penetrations of metal panel system. Retain subparagraphs below if additional requirements are necessary; revise to include more specific information about conference.

1.5 ACTION SUBMITTALS

- A. **Product Data:** Manufacturer's data sheets for specified products.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. **Shop Drawings:** Show layouts of metal panels. Include details of each condition of installation, panel profiles, and attachment to building. Provide details at a minimum scale 1-1/2-inch per foot of edge conditions, joints, fastener and sealant placement, flashings, openings, penetrations, and special details. Make distinctions between factory and field assembled work.
 - 1. Include data indicating compliance with performance requirements.
 - 2. Indicate points of supporting structure that must coordinate with metal panel system installation.
 - 3. Include structural data indicating compliance with performance requirements and requirements of local authorities having jurisdiction.
- C. **Samples for Initial Selection:** For each exposed product specified including sealants. Provide representative color charts of manufacturer's full range of colors.
- D. **Samples for Verification:** For each type of exposed finish, prepared on Samples of size indicated below:
 - 1. Metal Panels: Provide 12-inch long section of each metal panel profile.
 - 2. Provide color chip verifying color selection.

1.6 INFORMATIONAL SUBMITTALS

- A. **Qualification Data:** For manufacturer and Installer.
- B. **Product Test Reports:** For each product, for tests performed by a qualified testing agency.
- C. **Field quality-control reports.**
- D. **Sample Warranties:** For special warranties.

1.7 CLOSEOUT SUBMITTALS

- A. **Maintenance Data:** For metal panels to include in maintenance manuals.
- B. **Manufacturer's Warranty:** Executed copy of manufacturer's warranty.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect products of metal panel system during shipping, handling, and storage to prevent staining, denting, deterioration of components or other damage. Protect panels and trim bundles during shipping. Protect painted surfaces with a protective covering before shipping.
 - 1. Deliver, unload, store, and erect metal panels and accessory items without deforming panels or exposing panels to surface damage from weather or construction operations.
 - 2. Store in accordance with Manufacturer's written instructions.
 - 3. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
 - 4. Shield foam insulated metal panels from direct sunlight until all components are installed.

1.9 CODE / STANDARD COMPLIANCE

- A. Product Compliance: The roofing system shall have a State of Florida Product Control Notice of Acceptance (NOA) and meet all requirements of the Florida Product Approval System as required by Florida Statute 553.842 and Florida Administrative Code 9B-72.
- B. Comply with the following testing procedures:
 - 1. Florida Building Code Test Protocol TAS 105-Test Procedure for Field Withdrawal Resistance Testing.
 - 2. Florida Building Code Test Protocol TAS 114-Test Procedures for Roof System as the High Velocity Hurricane Zone Jurisdiction.
 - a. Appendix A- Test Procedure for Above Deck Combustibility ASTM E 108.
 - b. Appendix C-Test Procedure for Simulated Uplift Pressure Resistance of Roof System Assemblies.

1.10 WARRANTY

- A. Special Manufacturer's Warranty: Submit Manufacturer's two (2) year limited warranty providing panels to be free from defects in materials and workmanship, beginning from the date of substantial completion excluding coil coatings (paint finishes) that are covered under a separate warranty.
- B. The installation contractor shall issue a separate warranty against defects in installed materials and workmanship, beginning from the date of substantial completion of the installation.
- C. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, chipping, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Basis of Design Manufacturer: Metl-Span, a Division of NCI Group, Inc., or approved equal.

2.2 PERFORMANCE REQUIREMENTS

- A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 29 percent.
- B. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
 - 3. Deflection Limits: For wind loads, no greater than 1/240 of the span.
- C. Air Infiltration: Air leakage of not more than 0.0009 cfm/sq. ft when tested according to ASTM E 283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft.
- D. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
- F. Thermal Performance: When tested in accordance with ASTM C 518, Measurement of Steady State thermal Transmission, the panels shall provide a k factor of 0.14 btu/sf/hr/deg F at a 75° F mean temperature, as required by code, or 0.126 btu/sf/hr/deg F at a 40° F mean temperature.
- G. Fire-Test-Response Characteristics: Provide metal wall panels and system components with the following fire-test-response characteristics, as determined by testing identical panels and system components per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.
 - 1. Fire-Resistance Characteristics: Provide materials and construction tested for fire resistance per ASTM E 119.
 - 2. Intermediate-Scale Multistory Fire Test: Tested mockup, representative of completed multistory wall assembly of which wall panel is a part, complies with NFPA 285 for test method and required fire-test-response characteristics of exterior non-load-bearing wall panel assemblies.
 - 3. Radiant Heat Exposure: No ignition when tested according to NFPA 268.
 - 4. Potential Heat: Acceptable level when tested according to NFPA 259.
 - 5. Surface-Burning Characteristics: Provide wall panels with a flame-spread index of 25 or less and a smoke-developed index of 450 or less, per ASTM E 84.

2.3 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS

- A. General: Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.
- B. Wide-Reveal-Joint, Concealed-Fastener Metal Wall Panels <Insert drawing designation>: Formed with [vertical] [horizontal] panel edges and a corrugated profile between panel edges, resulting in a wide reveal joint between panels.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Berridge Manufacturing Company; HC-16
 - 2. Aluminum Sheet: Coil-coated sheet, ASTM B 209, Alloy 3105 as standard with manufacturer, with H14 temper as required to suit forming operations and structural performance required.
 - a. Surface: Smooth finish.
 - b. Exterior Finish: Two-coat [Mica] [Metallic] fluoropolymer.
 - c. Color: As selected by Architect/Owner from manufacturer's premium colors.
 - 3. Panel Coverage: 16 inches.
 - 4. Panel Height: 0.875 inches.

2.4 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 40 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Grace Ultra
 - b. Mid-States Asphalt Quick Stick HT Pro
 - c. Polyglass Polystick MTS
 - d. Soprema Lastobond Shield HT
 - e. Tamko TW Underlayment or TW Metal & Tile Underlayment
 - f. Or Approved Equal
 - 2. Thermal Stability: Stable after testing at 240 deg F; ASTM D 1970.
 - 3. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D 1970.
- B. Felt Underlayment: ASTM D 226/D 22M, Type II (No. 30), asphalt-saturated organic felts.

2.5 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 hot-dip galvanized coating designation or ASTM A 792/A 792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
 - 1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
 - 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 - 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
 - 1. Sealant Tape: Provide Tape Mastic Sealants, Non-skinning sealants, and Urethane Sealants in accordance with manufacturers standards
 - 2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
 - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.6 FABRICATION

- A. General: Provide factory fabricated and finished metal panels, trim, and accessories meeting performance requirements, indicated profiles, and structural requirements.
- B. Fabricate metal panel joints configured to accept sealant providing weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's written instructions, approved shop drawings, and project drawings.
- D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Sealed Joints: Form non expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
 - 3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

2.7 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Aluminum Panels and Accessories:
 - 1. Fluoropolymer Two-Coat System or Three-Coat System (to meet warranty requirements): AAMA 620. Primer with Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat meeting solar reflectance index requirements. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
 - 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
 - 2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
 - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 METAL PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
 3. Install screw fasteners in predrilled holes.
 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 5. Install flashing and trim as metal panel work proceeds.
 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
1. Aluminum Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use stainless steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
 2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
 3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
 4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
 5. Flash and seal panels with weather closures at perimeter of all openings.
- E. Watertight Installation:
1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels; and elsewhere as needed to make panels watertight.
 2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
 3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.
- F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.
- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4 FIELD QUALITY CONTROL

Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal wall panel installation, including accessories.

- B. Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified requirements.
- C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

3.5 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 42 13

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SECTION 07 60 00 - FLASHING AND SHEET METAL

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes:
 - 1. Sheet metal flashings, counterflashings, coping, downspouts, reglets, and all miscellaneous sheet metal work required for roofing and related work, complete as indicated on Drawings and by provision of this Section.
- B. Related Sections include the following:
 - 1. Division 6 Section "Rough Carpentry" for pressure treated wood nailers, blocking, and sheathing required for roofing work.
 - 2. Division 7 Section "Standing Seam Metal Roof Panels" for metal roofing system.
 - 3. Division 7 Section "Roof Accessories" for roof curbs, equipment supports and expansions joint assemblies.
 - 4. Division 7 Section "Joint Sealants" for sealing joints.
 - 5. Division 9 Section "Painting" for finish coating.

1.02 QUALITY ASSURANCE

- A. Installer's Qualifications: Flashing and sheet metal work shall be fabricated by a qualified sheet metal fabricator with at least five (5) years documented experience in installations of a similar nature.
- B. Reference Standards: Comply with provisions of the following, unless otherwise indicated or specified:
 - 1. American Architectural Manufacturers Association (AAMA):
 - a. Referenced Standards.
 - 2. American Society for Testing and Materials (ASTM):
 - a. Referenced Standards.
 - 3. Factory Mutual Global (FMG):
 - a. Referenced Standards.
 - 4. Federal Specifications (FS):
 - a. Referenced Standards.
 - 5. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
 - a. Referenced Standards.

C. Performance Requirements:

1. Wind Uplift Resistance: Installation of all sheet metal work and soffit system shall comply with FMG 1-90 wind uplift requirements in FMG Loss Prevention Data Sheet 1-28, "Wind Loads to Roof Systems and Roof Deck Securement."
2. The assemblies shall conform to the Florida Building Code requirements for Certification of Exterior Products and Materials (Notice of Approval).

1.03 SUBMITTALS

- A. Product Data: Submit complete product data, including manufacturer's material and finish data, installation instructions, and general recommendations for each specified flashing material and fabricated product.
- B. Shop Drawings: Complete shop drawings shall be prepared for all flashing and sheet metal work fabrication, soffit system, assembly, and attachment details, size of all members, fastening devices, supports and anchors, patterns, clearances, and all necessary connections to work of other trades.
- C. Installer's Qualifications: Submit documented evidence of installer's qualifications.
- D. Warranty: Submit specimen copy of specified warranty.

1.04 HANDLING AND STORAGE

- A. Sheet metal materials shall be carefully handled to prevent damage to surfaces, edges, and ends; and shall be stored at the site above the ground in a covered, dry location. Damaged items that cannot be restored to original condition will be rejected and shall be replaced at no additional cost to the Owner.

1.05 PROJECT CONDITIONS

- A. Coordinate work of this Section with interfacing and adjoining work for proper sequencing of each installation. Ensure best possible weather resistance and durability of work and protection of materials and finishes.

1.06 WARRANTY

- A. Finish Warranty: Provide manufacturer's standard fifteen (15) year written performance warranty.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Pre-Finished Galvanized (Hot-Dipped) Sheet Metal Material:

1. Pre-finished galvanized (hot-dipped) sheet metal coping, rain gutters and downspouts, and all miscellaneous sheet metal items indicated on Drawings shall be fabricated to shapes detailed on Drawings.
2. Galvanized steel sheet shall comply with ASTM A 653, G 90, commercial quality, for hot-dip galvanized steel sheet, mill phosphatized where indicated for painting. Provide minimum 24 gauge material thickness, unless otherwise indicated on Drawings.
3. Pre-Finish:

- a. Provide manufacturer's standard fluoropolymer 2-coat thermocured coating system composed of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.
 - (1) Color to be selected by Architect/Engineer and/or Owner.
- b. Products, Resin Manufacturers: Provide fluoropolymer coating systems containing one of the following resins:
 - (1) "Hylar 5000"; Ausimont USA, Inc.
 - (2) "Kynar 500"; Atofina Chemicals, Inc.

2.03 FABRICATION

- A. Shop fabricate work to greatest extent possible, with applicable requirements of SMACNA "Architectural Sheet Metal Manual" and other recognized industry practices. Fabricate for waterproof and weather-resistant performance; with expansion provisions for running work, sufficient to permanently prevent leakage, damage or deterioration of the work.
- B. Form work to fit substrates. Comply with material manufacturer's published instructions and current recommendations for forming material. Form exposed sheet metal work without excessive oil-canning, buckling and tool marks, true to line and levels indicated, with exposed edges folded back to form hems.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Surfaces that are to receive sheet metal work shall be even, smooth, sound, thoroughly clean and dry, and free from defects that might affect their application.

3.02 INSTALLATION

- A. Install sheet metal fabrications as required for the work.
- B. Perform cutting, fitting, drilling, and other operations as required to complete the work. Accessories and other components necessary to complete the work, whether or not specifically indicated or specified, shall be provided. Where sheet metal abuts or extends into adjacent materials, the juncture shall be executed in a manner to ensure weathertight construction.
- C. Manufactured items shall be installed in strict accordance with manufacturer's published instructions.
- D. All surfaces exposed to view shall be installed using continuous cleats to provide no visible fasteners.

3.03 CLEAN UP

- A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.

END OF SECTION 07 60 00

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SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes:
 - 1. Joint sealants and caulking as indicated on the Drawings and as specified herein.
- B. Related Sections include the following:
 - 1. Division 4 Section "Unit Masonry" for sealing joints in masonry construction.
 - 2. Division 8 Section "Steel Doors and Frames" for sealing joints in steel door frames.
 - 3. Division 8 Section "Overhead Coiling Doors" for sealing joints in overhead coiling door frames.
 - 4. Division 9 Section "Gypsum Wallboard" for sealing interior joints.

1.02 QUALITY ASSURANCE

- A. Installer Qualifications: The Installer shall have a minimum of five (5) years continuous documented experience in the application of the types of materials required, and approved or licensed by the manufacturer to install elastomeric sealants required for this Project.
- B. Product Testing: Obtain test results for test reports required as submittals from a qualified testing agency based on testing current sealant formulations within a 36 month period preceding commencement of the Work.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
 - 2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.
 - 3. Test other joint sealants for compliance with requirements indicated by referencing standard specification and test methods.
- C. Performance Requirements: Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

1.03 SUBMITTALS

- A. Product Data: Submit complete manufacturer's technical data for each manufactured item. Include the following:
 - 1. Certification that each product to be furnished is recommended for the application shown.
 - 2. Complete instructions for handling, storage, mixing, priming, installation, curing, and protection of each type of sealant.
- B. Samples: Submit the following samples:

1. One tube, in original sealed container, of each sealant specified.
 2. 12 inch length of each joint filler specified.
- C. Qualification Data: For Installer and testing agency.
- D. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
1. Materials forming joint substrates and joint sealant backings have been tested for compatibility and adhesion with joint sealants.
 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

1.04 PRODUCT DELIVERY AND STORAGE

- A. Deliver all products to the Project site undamaged, and in the manufacturer's original packing. Store products within the manufacturers' published temperature tolerances.

1.05 ENVIRONMENTAL CONDITIONS

- A. Do not install joint sealant materials when the ambient and substrate temperatures are below 40 degrees F, unless the manufacturer specifically recommends application of materials at lower temperatures. If Project progress or any other condition requires installations when ambient and substrate temperatures are below 40 degrees F (or below the minimum installation temperature recommended by the manufacturer), consult the manufacturer's representative and establish the minimum provisions required to ensure satisfactory work. Record in writing to the manufacturer, with a copy to the Architect/Engineer, the conditions under which such installation must proceed, and the provisions made to ensure satisfactory work.
- B. Do not proceed with installation of bulk compounds during inclement weather unless the full compliance with all requirements and manufacturer's published instructions.
- C. Do not proceed with the installation of elastomeric sealants under extreme temperature conditions which would cause joint openings to be at either maximum or minimum width, or when such extreme temperatures or heavy wind loads are forecast during the period required for initial or nominal cure of elastomeric sealants. Whenever possible, schedule the installation and cure of elastomeric sealants during periods of mean temperatures (nominal joint width shown) so that subsequent stresses upon the cured sealants will be minimized.

1.06 WARRANTY

- A. Special Project Warranty: Provide a written warranty, signed by the installer and Contractor, against defects materials and workmanship for joint sealants which fail to perform as airtight or watertight joints; or fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, or general durability; or appear to deteriorate in any other manner not clearly specified in joint sealant manufacturer's published data as an inherent quality of the material for the exposure indicated.
1. Warranty Period: Five (5) years from the date of Final Acceptance.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Hardnesses indicated and specified are intended to indicate the general range necessary for overall performance. The manufacturer's technical representative shall determine the actual hardness recommended for the conditions of installation and use. Except as otherwise indicated or recommended, compounds shall be provided within the range of hardness (Shore A, Fully cured, at 75 degrees F) of 25 to 40.
- B. Prior to installation of each specified sealant, confirm its compatibility with the joint surfaces, joint fillers, and other materials in the joint system. Only materials that are known to be fully compatible with the actual installation conditions, as shown by manufacturer's published data or certification, shall be provided.

2.02 SEALANTS

- A. Exterior Sealants: Sealants for exterior locations and all interior and exterior expansion joints shall be cold-applied elastomeric joint sealant, two-part polyurethane sealant complying with ASTM C 920.
 - 1. Products, Horizontal Joints: Provide one of the following Type M (multicomponent), Class 25, Use T (traffic) sealants:
 - a. AUrexpan NR-200"; Pecora Corporation.
 - b. "Vulkem 245"; Tremco.
 - c. "Sonolastic SL 2"; Sonneborn, Div. of ChemRex Inc.
 - 2. Products, Vertical Joints: Provide one of the following Type M (multicomponent), Class 25, Use NT (nontraffic) sealants:
 - a. "Dynatrol II"; Pecora Corporation.
 - b. "Vulkem 227"; Tremco.
 - c. "Sonolastic NP 2"; Sonneborn, Div. of ChemRex Inc.
- B. Interior Sealants: Sealants for interior locations shall be acrylic latex sealant compound, non-staining, non-bleeding, paintable, complying with ASTM C 834.
 - 1. Products: Provide one of the following sealants:
 - a. "AC-20+"; Pecora Corporation.
 - b. "Sonolac"; Sonneborn, Div. of ChemRex Inc.
 - c. "Tremflex 834"; Tremco.

2.03 MISCELLANEOUS MATERIALS

- A. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum

adhesion of sealants to joint substrates.

- B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by the sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.
- C. Backer Rods: Provide closed-cell, expanded polyethylene backer rods. The size and shape of the rod shall be that which will control the joint, form optimum shape of sealant bead on the back side, and provide a highly compressible backer to minimize the possibility of sealant extrusion when the joint is compressed.
 - 1. Basis of Design: "Ethafoam"; Dow Chemical Company.

2.04 COLORS

- A. For concealed joints, provide manufacturer's standard color from the product that has the best overall performance qualities for the application shown. For exposed joints, the Architect/Engineer and/or Owner will select colors from the manufacturer's standard or premium line of colors from the product that provides the match to the materials.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean concrete, masonry, and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean metal and similar nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming: Prime joint substrates, where recommended in writing by joint sealant manufacturer, based on prior experience. Apply primer to comply with joint sealant

manufacturer's written instructions. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.

- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 JOINT SEALANT INSTALLATION

- A. General: Comply with joint sealant manufacturers' published instructions, unless more stringent requirements are shown or specified, or the manufacturer's technical representative recommends otherwise.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Prime or seal joint surfaces as indicated or recommended by the sealant manufacturer. Do not spill or allow primers or sealers to migrate onto adjoining surfaces.
- D. Install sealant backer rods for all elastomeric sealants, unless indicated to be omitted or recommended to be omitted by sealant manufacturer for the application shown.
- E. Install bond breaker tape where required by manufacturer's recommendations to ensure that elastomeric sealants will perform properly, or as indicated on the Drawings.
- F. Employ only proven installation techniques that will ensure sealants are deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of the joint bond surfaces equally on opposite sides. Unless otherwise indicated, fill sealant joints to a slightly concave surface and slightly below adjoining surfaces. Where horizontal joints occur between a horizontal surface and a vertical surface, fill joints to form a slight cove, so that the joint will not trap moisture and dirt.
 - 1. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- G. Install sealants to depths indicated, or if not indicated, as recommended by the sealant manufacturer, but within the following general limitations measured at the center (thin) section of the bead.
 - 1. For sidewalks, pavements, and similar joints sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposure, fill joints to a depth equal to 75 percent of the joint width, but neither more than 5/8 inch deep nor less than 3/8 inch deep.
 - 2. For normal moving joints sealed with elastomeric sealants, but not subject to traffic, Fill joints to a depth equal to 50 percent of joint width, but not more than 3/8 inch nor less than 1/4 inch.
 - 3. For joints sealed with non-elastomeric sealant compounds, fill joints to a depth in the range of 75 percent to 115 percent of the joint width.
- H. Do not permit joint sealant materials (primers, sealers, or sealants) to spill onto adjoining surfaces, or be allowed to migrate into the voids of adjoining surfaces including rough textures. Use masking tape or other precautionary devices to prevent staining of adjoining surfaces.

- I. Promptly remove excess sealant from surfaces adjacent to joints as the work progresses. Clean adjoining surfaces as necessary to eliminate evidence of spillage, without damage to the adjoining surfaces or finishes.

3.04 CURE AND PROTECTION

- A. Cure sealants in compliance with the manufacturer's published instructions and current recommendations to obtain high early bond strength, internal cohesive strength, and surface durability.
- B. The installer shall advise the Contractor of procedures required for the curing and protection of sealants compounds during the construction period, so that they will be without deterioration or damage (other than normal wear and weathering), at the time of Final Acceptance.

END OF SECTION 07 92 00

DIVISION 08

SECTION 08 11 13 - STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes:
 - 1. Steel Doors and frames.
- B. Related Sections include the following:
 - 1. Division 4 Section "Unit Masonry" for masonry work.
 - 2. Division 7 Section "Joint Sealants" for elastomeric sealants.
 - 3. Division 8 Section "Aluminum Entrances and Storefronts" for entrance system.
 - 4. Division 8 Section "Door Hardware" for operating hardware.
 - 5. Division 9 Section "Painting" for finishing doors and frames.

1.02 QUALITY ASSURANCE

- A. Approved Products: As applicable, products used herein shall comply with requirements of the Florida Product Approval System as required by Florida Statute 553.842 and Florida Administrative Code 9B-72.
- B. Manufacturer/Fabricator: Steel doors and frames shall be manufactured by a single firm specializing in the production of this type of work.
- C. Reference Standards: Comply with provisions of the following, unless otherwise indicated or specified:
 - 1. American National Standards Institute (ANSI):
 - a. Referenced Standards.
 - 2. American Society for Testing and Materials (ASTM):
 - a. Referenced Standards.
 - 3. Glass Association of North America (GANA):
 - a. Referenced Standards.
 - 4. National Fire Protection Association (NFPA):
 - a. Referenced Standards.
 - 5. Steel Door Institute (SDI):
 - a. SDI 100 Recommended Specifications for Standard Steel Doors and Frames.
 - b. SDI 105 Recommended Erection Instructions for Steel Frames.

- D. Fire-Resistance Classifications: Where fire-resistance classifications are shown or scheduled for steel doors and frame assemblies, the doors and frames shall comply with the requirements of NFPA 80, and shall have been tested and rated with the appropriate hardware by Underwriters Laboratories (UL). A UL label shall be provided on each door and frame so classified.
- E. Wind Resistance: Exterior door assemblies shall comply with Florida Building Code Test Protocol TAS 201- Impact and Test Procedures and Test Protocol TAS 203 - Criteria for Testing Products Subject to Cyclic Wind Pressure Loading.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's technical information and installation instructions for each type of door and frame.
- B. Shop Drawings: Submit shop drawings for steel doors and frames as follows, and as a package with submittals for other doors and finish hardware to enable a coordinated review of all door openings for the Project.
 - 1. Submit shop drawings for the fabrication and installation of the steel doors and frames. Drawings shall include details of each frame type, elevations of door design types, louvers, conditions at openings, details of construction, location and installation requirements of finish hardware, and reinforcements and details of joints and connections, showing anchorage and accessory items.
 - 2. Shop drawings shall indicate accurate dimensions of work shown. Frame returns shall allow for conditions (i.e. 5/8 inch gypsum board or exposed masonry as scheduled). Except where otherwise shown, 1/4 inch sealant space shall be provided for each jamb and head abutting wall materials.
 - 3. Shop drawings shall list and locate all items of finish hardware furnished under other Sections of the Specifications, but prepared for by the manufacturer of hollow metal doors and frames, from templates provided by the hardware supplier.
- C. Schedule:
 - 1. A schedule of doors and frames shall be provided using the same opening numbers referenced on the Drawings and the same schedule format.

1.04 PRODUCT DELIVERY AND STORAGE

- A. Doors and frames shall be protected during transit, storage, and handling to prevent damage, soiling, and deterioration.
- B. Each door shall be packaged at the factory in a separate heavy paper carton. Each carton shall be marked for location to correspond with the Shop Drawings.
- C. Ship welded frames in bundles securely strapped or in packages with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- D. Store doors and frames at the building site under cover. Frames shall be stored in an upright position. Place the units on at least 4 inch wood sills or on floors in a manner that will prevent rust or damage. Avoid the use of nonvented plastic or canvas shelters that create a humidity chamber. If the wrapper on the door becomes wet, remove the carton immediately. Provide a 1/4 inch air space between the doors to promote air circulation.

1.05 PROJECT CONDITIONS

- A. Field Measurements: Obtain and verify all measurements at the buildings as required to properly fabricate and install all special door and frame requirements if and when they occur. Verify all conditions that may affect door installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products: Provide one of the following:
 - 1. "Lock Seam Design"; American Steel Products.
 - 2. "Series HT"; Pioneer Industries, Inc.
 - 3. "Series LW"; Steelcraft/Ingersoll Rand.

2.02 MATERIALS AND FABRICATION

- A. Pressed Steel Frames:
 - 1. Frames shall be double rabbeted design, depth and profile as detailed and furnished with minimum 5/8 inch stop. Frames shall be fabricated from 14 gauge (exterior openings) and 16 gauge (interior openings) commercial quality, level, cold-rolled steel conforming to ASTM A 1008 or hot-rolled, pickled and oiled steel conforming to ASTM A 1011.
 - 2. Frames shall have zinc coating applied by hot-dip process conforming to ASTM A 653 (G60) with coating weight not less than 0.60 oz. per square foot (0.30 oz. per square foot per side). Frames shall be designed with integral stop and trim.
 - 3. Frame corners shall be mitered and continuously arc welded (both inside of mitered corners and butt edges) with all exposed welds ground and sanded smooth. Mitered corners shall be reinforced with 18-gauge channel-shaped reinforcements.
 - 4. Head members shall be 2 inches high unless otherwise indicated.
 - 5. Strike jambs shall be provided with three (3) holes for rubber bumpers (silencers); refer to Section 08 71 00 - DOOR HARDWARE for furnishing and installation of silencers.
- B. Steel Doors:
 - 1. Hollow metal steel doors shall be fabricated from 18 gauge commercial quality, level, cold-rolled steel conforming to ASTM A 1008 or hot-rolled, pickled and oiled steel conforming to ASTM A 1011. Face sheets for doors shall have zinc coating applied by hot-dip process conforming to ASTM A 653 (G60) with coating weight not less than 0.60 oz. per square foot (0.30 oz. per square foot per side).
 - 2. Door face sheets shall be 1-3/4 inches thick heavy-duty, full flush hollow steel formed from one sheet of metal with no seams permitted on the door face. Lock seam shall occur on hinge edge with seam continuously welded and welds ground smooth. Tops shall be flush and closed with no holes. Top and bottom of door shall be closed with a minimum 16 gauge flush or inverted closure channel.
 - 3. A full-width dense rigid polyurethane core conforming to ASTM C 591 shall be installed in all doors to provide dimensional stability and high resistance to facial impact.
 - 4. The clearances for doors shall be 3/32- to 1/8-inch at jambs and heads. The lock edges of

stiles shall be beveled 1/8 inch in 2 inches for steel doors.

5. The top and bottom edges of all exterior steel doors shall be closed to provide a weather seal. This seal shall be provided as part of the door construction or by the addition of inverted steel channels or other suitable shapes welded, caulked and sealed to the face sheets and formed (shaped) so the assembly will not retain water.
6. All exterior double doors shall have a steel astragal attached to the active leaf.
7. Louvers shall be manufacturer's standard sightproof stationary louvers constructed of inverted V-shaped or Y-shaped blades formed of 18 gauge cold-rolled galvanized steel set into 18-gauge galvanized steel frame. Use type louver for exterior doors as recommended by door manufacturer.
 - a. Provide manufacturer's standard insect and bird screen backup for all louvers and louvered doors. Screens shall be removable for maintenance and cleaning.

C. Labeled Steel Doors and Frames:

1. Where indicated on Drawings, furnish UL Labels with appropriate fire resistance ratings for the class of opening specified. Both doors and frame shall have label attached. Construction details and hardware application shall be as approved by the labeling authority.
2. All approved fire doors shall be arranged to either remain in normally closed position with suitable self-closing device or in normally open position with a fusible element or smoke detector actuated mechanism which will close the door automatically in case of fire, as indicated on Drawings and/or as required by governing authorities.
3. Pairs of UL label fire doors shall have an overlapping steel astragal welded or bolted to the active leaf.
4. The clearances for fire doors shall be as required by the authority having jurisdiction.
5. Louvers shall be door manufacturer's standard as specified above under Paragraph 2.02, B.7.; equipped with UL approved fusible link fire damper for label required.

D. Exterior Door Louvers:

1. Fabricate louvers and mount flush into doors without overlapping moldings on surface of door facing sheets.
2. Provide internal support as recommended by louver manufacturer. Prime paint after fabrication.
3. Provide not less than 16 gage galvanized steel sheet. Fabricate units with stationary, weatherproof Z-shaped blades and U-shaped frames, not less than 1-3/4 inches thick. Space louver blades not more than 1-1/2 inches o.c. Assemble units by welding. Provide removable insect screens on interior side of frame, consisting of 18-14 aluminum wire mesh, 0.011 inch diameter, in rigid, formed metal frame.

- E. Fire-Rated Door Louvers: Louvers shall be manufacturer's standard sightproof stationary louvers constructed of inverted V-shaped or Y-shaped blades formed of 18 gauge cold-rolled galvanized steel set into 18-gauge galvanized steel frame. Use weather-tight type louver for exterior doors as recommended by door manufacturer.

1. Louvers shall be equipped with UL approved fusible link fire damper for label required.
2. Provide manufacturer's standard insect and bird screen backup for all louvers. Screens shall be removable for maintenance and cleaning.

G. Metal Finishes:

1. Shop Applied Primer Finish:
 - a. Apply a primed finish to all galvanized and non-galvanized metal surfaces furnished under this Section. Clean and chemically treat metal surfaces to assure maximum paint adhesion; follow with a dip or spray coat of rust-inhibitive metallic oxide, zinc chromate, or synthetic resin primer on all exposed surfaces.
 - b. Finished surfaces shall be smooth and free from irregularities and rough spots. Paint shall be baked or oven dried. the time and temperature for drying shall be in accordance with manufacturer's recommendations for developing maximum hardness and resistance to abrasion.
2. Field Paint Finish: Finish painting of steel doors and frames is specified under Section 09 91 00 - PAINTING.

H. Hardware Provisions and Reinforcing:

1. Hardware Provisions for Pressed Steel Frames:
 - a. Unless a different strike is noted on Hardware Schedule, frames shall have steel hinge plate reinforcement projection welded with provisions for 4-1/2 inch x 4-1/2 inch full mortise type hinges and steel strike tap plate reinforcement projection welded with provisions for Universal ANSI A115.1 or A115.2 strike.
 - b. Frames shall be provided for 1-1/2 pair of hinges, unless noted otherwise. Mortar guards shall be formed from 26-gauge galvanized steel and shall be welded in place.
 - c. Closer reinforcement shall be sleeve type installed in frame header for all doors that are indicated to receive door closers.
 - d. Provide metal reinforcements for all other hardware items indicated.
 - e. Minimum gauges of hardware reinforcing plates shall be as follows:

(1) Hinge Reinforcements:	8 gauge, 1-1/4 x 10-inch min. size.
(2) Lock Reinforcements:	12 gauge.
(3) Closer Reinforcements:	12 gauge.
(4) Surface-Mounted Hardware:	12 gauge.
2. Hardware Provisions for Steel Doors:
 - a. Mortise, reinforce, drill and tap doors at the factory to receive all mortised type hardware. Drilling and tapping for surface applied hardware shall be performed in field. Provide concealed metal reinforcement for surface applied hardware indicated in the Hardware Schedule.
 - b. Doors shall have steel integral hinge reinforcement with provisions for 4-1/2

inch x 4-1/2 inch full mortise template type hinges for 1-1/2 pair of hinges per door, unless noted otherwise.

- c. Doors shall have steel integral lock reinforcement with provisions for locksets as indicated.
- d. Doors shall have steel closer reinforcement concealed in the door for all doors that are indicated to receive closers.
- e. Minimum gauges for hardware reinforcing plates shall be as follows:
 - (1) Hinge Reinforcements: 8 gauge.
 - (2) Lock Reinforcements: 12 gauge.
 - (3) Closer Reinforcements: 12 gauge.
 - (4) Surface Mounted Hardware: 16 gauge.

I. Location of Hardware: The location of hardware in connection with hinged and other swing type hollow metal doors and frames shall be as follows, unless indicated or specified otherwise:

- 1. Top Hinge: To manufacturer's standard, but not greater than 5 inches from head rabbet to top of hinge.
- 2. Bottom Hinge: To manufacturer's standard but not greater than 10 inches from finish floor to bottom of hinge.
- 3. Intermediate Hinge: Equally spaced between top and bottom hinge.
- 4. Locks (cylindrical, mortise, unit or integral): 38 inches from finish floor to center of strike.
- 5. Refer to Section 08 71 00 - DOOR HARDWARE for additional locations.

J. Frame Anchors:

- 1. All frames shall have an integral or welded on sill anchor.
- 2. Furnish six (6) per frame, 10 inch long corrugated or other deformed type adjustable anchors as condition applies.

2.03 FABRICATION

- A. All work shall be shop fabricated to required profiles by forming and welding with corners, angles and edges straight and sharp.
- B. Fit and fabricate accurately with corners, joints, seams and surfaces free from warp, buckles or other defects.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine the areas and conditions under which steel doors and frames are to be installed. Do not proceed with steel door and frame installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General: Install standard steel doors, frames and accessories in accordance with approved shop drawings, manufacturer's data and as herein specified.
- B. Steel Frames:
 - 1. Comply with provisions of SDI A250.11 or NAAMM-HMMA 840, unless otherwise indicated.
 - 2. Except for frames located at in-place drywall installations, place frames prior to construction of enclosing walls and ceilings. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.
 - 3. In masonry and cast-in-place concrete construction, wall anchors shall be located at the hinge and strike levels, and frames shall be grouted solid (Jambs and Heads).
 - 4. Install fire-rated frames in accordance with NFPA 80.
 - 5. In concrete construction, locate three (3) wall anchors per jamb at hinge and strike levels.
 - 6. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
 - 7. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - 8. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
 - 9. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 - 10. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
 - 11. In-Place Concrete or Masonry Construction: Secure frames in place with post installed expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 - 12. In-Place Metal-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
- C. Steel Doors:
 - 1. Fit steel doors accurately in frames, within clearances specified in SDI 100.
 - 2. Place fire-rated doors with clearances as specified in NFPA 80.

3.03 ADJUST AND CLEAN

- A. Prime Coat Touch-up: Immediately after installation, sand smooth all rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.
- B. Final Adjustments: Check and readjust operating finish hardware items, leaving steel doors and

frames undamaged and in complete and proper operating condition.

- C. Cleaning: Immediately prior to final inspection and before Final Acceptance, remove all protective materials and clean all exposed members. Do not use abrasives or harmful cleaning agents.

END OF SECTION 08 11 13

SECTION 08 33 23 - OVERHEAD COILING DOORS

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes:
 - 1. Overhead Coiling Motorized Insulated Service Doors.
- B. Related Sections include the following:
 - 1. Division 4 Section “Unit Masonry” for masonry work.
 - 2. Division 5 Section “Metal Fabrications” for structural steel channel frame.
 - 3. Division 8 Section “Steel Doors and Frames” for steel entry doors and frames.

1.02 QUALITY ASSURANCE

- A. Approved Products: As applicable, products used herein shall comply with requirements of the Florida Product Approval System as required by Florida Statute 553.842 and Florida Administrative Code 9B-72.
- B. Single Source Responsibility: Furnish overhead coiling doors as complete units produced by one manufacturer, including hardware, accessories, mounting and installation components.
- C. Installer's Qualifications: Installation shall be performed only by manufacturer authorized installers with at least five (5) years' experience in installation of a similar nature, and as approved by the Architect/Engineer.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, roughing-in diagrams, and installation instructions for type and size of overhead door. Provide operating instructions and maintenance information. Include motor wiring diagram.
- B. Shop Drawings: Submit complete shop drawings indicating the materials, size of unit, and methods of securing to the steel channel framed opening. Manufacturer's names and numbers of products shall be clearly indicated on all shop drawings.

1.04 DELIVERY, STORAGE AND HANDLING

- A. All materials and accessories shall be delivered to the Project Site in the manufacturer's original, unopened, labeled containers or packages, and shall be stored in enclosed and protected areas until time of installation.

1.05 PROJECT CONDITIONS

- A. Field Measurements: Examine and field measure door opening prior to fabrication to ensure proper fit of work. Show measurements on final shop drawings.
- B. Coordination: Coordinate electrical power wiring requirements and connections with requirements Division 26 - ELECTRICAL.

PART 2 - PRODUCTS

2.01 MANUFACTURER/TYPE

- A. Rolling Service Doors, Face of Wall Mount, Motor Operated; The Cookson Company, Inc., Overhead Door Corporation, or approved equal.

2.02 MATERIALS AND CONSTRUCTION

A. Curtain:

1. Slats: Cold roll flat formed in continuous lengths of galvanized steel interlocked to form curtains.
 - a. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84 or UL 723. Enclose insulation completely within slat faces.
2. Endlocks: Each end of alternate slats shall be fitted with endlocks to act as a wearing surface in the guides and to remain slat alignment.
3. Windload Resistance: Door construction shall be designed to satisfy windload per Florida Building Code, Latest Adopted Edition, as amended.
4. Gauge: Thickness of slat material shall be determined by width of opening and wind loading requirements.
5. Galvanizing: Zinc coated in accordance with ASTM A 563, G90.
6. Bottom Bar: Curtain shall be reinforced with a bottom bar consisting of steel angles.

B. Spring Counterbalance:

1. Counterbalance: House in a steel pipe of diameter and wall thickness to restrict maximum deflection to .03 inch per foot of door width.
2. Springs: Helical torsion designed to include an overload factor of 25 percent and for optimum ease of operation. Springs shall be grease packed and mounted on a cold rolled steel inner shaft.
3. Spring Tension: Adjustable from outside of end bracket plate.
4. Ball Bearing: Sealed, to minimize wear of pipe shaft rotation around inner shaft.

C. Bracket Plates:

1. Bracket Plates: Plates shall carry pipe counterbalancing shaft and be not less than 1/4" thick to house ends of door coil.
2. Drive End Bracket Plate: Plate shall be fitted with a sealed ball bearing.

D. Guide and Wall Angle Assembly:

1. Guides/Wall Angles: Structural steel angles of 3/16" minimum thickness.

- 2. Depth of Guide: Provide adequate slat penetration to satisfy required wind loading.
- E. Hoods:
 - 1. Hoods to house coil shall be fabricated of 24 gauge galvanized steel to match curtain finish.
 - 2. Reinforcing: Provide lateral reinforcing to prevent sag.
 - 3. Intermediate Hood Supports: Provide where door width exceeds 16-feet.
- F. Locking:
 - 1. Provide integral gearing of motor operator to provide locking of door.
- G. Weatherstripping:
 - 1. Doors shall be fully weatherstripped at sill, hood and guides.
- H. Motor Operator:
 - 1. 1/2 HP, 208-230 Voltage, 3 Phase, 2.1 Amp, with emergency auxiliary hand chain. Provide interior mounted 3-button push button station for each door.
- I. Safety Edge:
 - 1. Provide safety edges for motor operated door. Upon contact with obstruction, door shall stop and reverse to open position.
- J. Finish:
 - 1. Factory applied powder-coat 500 finish to both faces of door and all hardware. Color to be selected by Architect/Engineer and/or Owner.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with all necessary hardware, anchors, inserts, hangers, and equipment, supports in accordance with final shop drawings, manufacturer's instructions, and as herein specified.
- B. Upon completion of installation including work by other trades, lubricate, test and adjust doors to operate easily, free from warp, twist or distortion.
- C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

END OF SECTION 08 33 23

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SECTION 08 42 00 - ALUMINUM ENTRANCES AND STOREFRONTS

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes:
 - 1. Exterior aluminum storefront framing, entrances, and doors.
- B. Related Sections include the following:
 - 1. Division 7 Section “Joint Sealants” for elastomeric sealants.
 - 2. Division 8 Section “Steel Doors and Frames” for flush steel doors.
 - 3. Division 8 Section “Door Hardware” for aluminum and flush steel door operating hardware.
 - 4. Division 8 Section “Glass and Glazing” for glazing used in aluminum entrances and storefronts.

1.03 QUALITY ASSURANCE

- A. Approved Products: As applicable, products used herein shall comply with requirements of the Florida Product Approval System as required by Florida Statute 553.842 and Florida Administrative Code 9B-72.
- B. Code Compliance: Total installation must comply with the requirements of the Florida Building Code, latest adopted edition, as amended, including Test Protocols for High Velocity Hurricane Zones.
- C. Wind Loads: Installed windows to withstand wind pressure loads (positive and negative) normal to wall plane indicated in accordance with the Florida Building Code for the geographical location of the Project.
- D. Installer Qualifications: Capable of assuming engineering responsibility and performing work of this Section and who is acceptable to manufacturer.
 - 1. Engineering Responsibility: Preparation of data for aluminum-framed systems including shop drawings based on testing and engineering analysis of manufacturer’s standard units in assemblies similar to those indicated for this Project and submission of reports of tests performed on manufacturer’s standard assemblies.
- E. Testing Agency Qualifications: An independent agency qualified according to ASTM E 699 for testing indicated.
- F. Accessible Entrances: Comply with the U.S. Architectural & Transportation Barriers Compliance Board’s “Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG).”
- G. Welding: Qualify procedures and personnel according to AWS D1.2 “Structural Welding Code - Aluminum.”

1.04 PERFORMANCE REQUIREMENTS

- A. General: Provide aluminum-framed systems, including anchorage, capable of withstanding, without failure, the effects of the following:
1. Structural loads.
 2. Thermal movements.
 3. Movements of supporting structure indicated on Drawings including, but not limited to, deflection from uniformly distributed and concentrated live loads.
 4. Dimensional tolerances of building frame and other adjacent construction.
 5. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferred to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
 - d. Noise or vibration created by wind and thermal and structural movements.
 - e. Loosening or weakening of fasteners, attachments, and other components.
 - f. Sealant failure.
 - g. Failure of operating units to function properly.
- B. Deflection of Framing Members:
1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
 2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller.
- D. Structural Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:
1. When tested at positive and negative wind load design pressures, systems do not evidence deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent of main framing members exceeding 0.2 percent of span.
 3. Test Durations: As required by design wind velocity but not less than 10 seconds.
- E. Windborne-Debris-Impact-Resistance-Test Performance: Provide aluminum-framed systems that pass large and small missile-impact tests and cyclic-pressure tests according to Florida Building Code, latest adopted edition, as amended.
- F. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements from the following maximum change (range) in ambient and surface temperatures. Base engineering

calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F ambient; 180 deg F, material surfaces.
2. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
 - a. Test High Exterior Ambient Air Temperature: That which produces an exterior metal surface temperature of 180 deg F.
 - b. Test Low Exterior Ambient Air Temperature: 0 deg F.
- G. Water Penetration Under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind load design pressure, but not less than 6.24 lbf/sq. ft.
- H. Water Penetration Under Dynamic Pressure: Provide aluminum-framed systems that do not evidence water leakage through fixed glazing and framing areas when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of positive wind load design pressure, but not less than 6.24 lbf/sq. ft..
 1. Maximum Water Leakage: According to AAMA 501.1. Water controlled by flashing and gutters that is drained to exterior and cannot damage adjacent materials or finishes is not considered water leakage.
- I. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation resistance factor (CRF) of not less than 54 when tested according to AAMA 1503.
- J. Average Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having average U-factor of not more than 0.42 But/sq. ft. x h x deg F when tested according to AAMA 1503.

1.05 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated.
- B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
 1. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 2. Include details of provisions for system expansion and contraction and for draining moisture occurring within the system to the exterior.
 3. For entrances, coordinate with hardware supplier (Division 8 "Door Hardware") for hardware schedule and operating hardware types, functions, quantities, and locations.
- C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

- D. Welding certificates.
- E. Qualification Data: For Installer and testing agency.
- F. Field quality control test and inspection reports.
- G. Maintenance Data: For aluminum-framed system to include in maintenance manuals.
- H. Warranties: Special warranties specified in this Section.

1.06 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on shop drawings.

1.07 WARRANTY

- A. Special Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that deteriorate as defined in this Section within the specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration caused by thermal movements.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. Water leakage through fixed glazing and framing areas.
 - e. Failure of operating components to function properly.
 - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
 - 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURER/SYSTEM

- A. Subject to compliance with requirements, aluminum entrance and storefront system shall be as follows:
 - 1. Basis of Design: Model IR 500 Impact Resistant and Blast Mitigating Framing System as manufactured by Kawneer North America to match existing storefront system.

2.02 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209, Alloy 5005-H16.
 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221, Alloy 6063-T6.
 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 4. Structural Profiles: ASTM B 308.
 5. Welding Rods and Bare Electrodes: AWS A5.10.
- B. Steel Reinforcement: With manufacturer's standard corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

2.03 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Construction: Framing members are composite assemblies of two separate extruded aluminum components permanently bonded by an elastomeric material of low thermal conductance.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with non-staining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.
1. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
 2. Reinforce members as required to retain fastener threads.
 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- C. Concrete and Masonry Inserts: Hot-dip galvanized cast iron, malleable iron, or steel inserts complying with ASTM A 123 or ASTM A 153 requirements.
- D. Flashing: Manufacturer's standard corrosion-resistant, non-staining, nonbleeding flashing compatible with adjacent materials. Form exposed flashing from sheet aluminum finished to match framing and of sufficient thickness to maintain a flat appearance without visible deflection.
- E. Framing System Gaskets and Sealants: Manufacturer's standard recommended by manufacturer for joint type.

2.04 GLAZING SYSTEMS

- A. Glass: As specified in Section 08 81 80 "Glass and Glazing."
- B. Glazing Gaskets: Manufacturer's standard compression types, replaceable, molded or extruded, that maintain uniform pressure and watertight seal.

- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric types.
- D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

2.05 DOORS

- A. Doors, Basis of Design: Model 500 IR Impact Resistant and Blast Mitigating Entrance Doors as manufactured by Kawneer North America to match existing entrances.
 - 1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125 inch thick, extruded aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deep penetration and fillet welded or that incorporate concealed tie rods.
 - 2. Door Design: Medium stile as described herein.
 - a. Accessible Doors: Smooth surfaced for width of door in area within 10 inches above floor or ground plane.
 - 3. Glazing Stops and Gaskets: Beveled, snap-on, extruded aluminum stops and preformed gaskets.
 - a. Provide non-removable glazing stops on outside of door.

2.06 DOOR HARDWARE

- A. General: Provide heavy-duty units in sizes types and hardware manufacturers for entrances and uses indicated in Division 8 "Door Hardware" Section.
 - 1. Opening-Force Requirements, Egress Doors: Not more than 30 lbf required to set door in motion and not more than 15 lbf required to open door to minimum required width.
- B. Locking Devices, General: Do not require use of key, tool, or special knowledge for operation.
 - 1. Opening-Force Requirements:
 - a. Delayed-Egress Locks: Lock releases within 15 seconds after applying a force of not more than 15 lbf for not more than 3 seconds.
 - b. Latches and Exit Devices: Not more than 15 lbf required to release latch.
- C. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
 - 1. Standard: BHMA A156.3, Grade 1.
- D. Cylinders: As specified in Section 08 71 00 "Door Hardware."
- E. Strikes: Provide strike with black plastic dust box for each latch or lock bolt; fabricated for aluminum framing.
- F. Operating Trim: BHMA A156.6.

- G. Closers: With accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use, and adjustable to meet field conditions and requirements for opening force.
 - 1. Standard: BHMA A156.4, Grade 1.
- H. Weather Stripping: Manufacturer's standard replaceable components.
 - 1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
 - 2. Sliding Type: AAMA 701, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
- I. Weather Sweeps: Manufacturer's standard exterior door bottom sweep with concealed fasteners on mounting strip.
- J. Thresholds: Raised thresholds beveled with a slope of not more than 1:2, with maximum height of 2 inch.

2.07 ACCESSORY MATERIALS

- A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Section 07 92 00 "Joint Sealants."
- B. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.08 FABRICATION

- A. Form aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformation.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Means to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
 - 4. Physical and thermal isolation of glazing from framing members.
 - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 6. Provisions for field replacement of glazing from exterior.
 - 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing (without projecting stops).

- E. Door Frames: Reinforce as required to support loads imposed by door operation and for installing hardware:
 - 1. At exterior doors, provide compression weather stripping at fixed stops.
- F. Doors: Reinforce doors as required for installing hardware.
 - 1. At pairs of exterior doors, provide sliding weather stripping retained in adjustable strip mortised into door edge.
 - 2. At exterior doors, provide weather sweeps applied to door bottoms.
- G. Hardware Installation: Factory install hardware to the greatest extent possible. Cut, drill, and tap for factory-installed hardware before applying finishes.
- H. After fabrication, clearly mark components to identify their locations in Project according to shop drawings.

2.09 ALUMINUM FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.
- B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- C. Finish: Organic Coating (high performance fluorocarbon) conforming to AAMA 2605 as follows:
 - 1. Surfaces shall be cleaned and prepared using a conversion coating pre-treatment prior to application of 0.3 mil dry film thickness (DFT) of epoxy or acrylic primer in accordance coating manufacturer's written instruction.
 - 2. Finish coat of 70% minimum fluorocarbon resin fused to primed surfaces at temperature recommended by manufacturer to achieve minimum 1.0 mil DFT.
 - 3. Acceptable coating systems are:
 - a. Nubelar by Glidden Company.
 - b. Duranar by PPG Industries, Inc.
 - c. Fluropon by Valspar Corporation.
 - 4. Provide 3 or 4 coat system as required for color selected. Color shall be as selected by Architect/Engineer from manufacturer's full (standard and custom) color line and shall match curtain wall system.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure non-movement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints watertight, unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in a full bed of sealant as specified in Section 07 92 00 "Joint Sealants."

E. Install components plumb and true in alignment with established lines and grades, without warp or rack.

F. Install glazing as specified in Section 08 81 00 "Glass and Glazing."

G. Entrances: Install to produce smooth operation and tight fit at contact points.

1. Exterior Entrances: Install to produce tight fit at weather stripping and weathertight closure.
2. Field-Installed Hardware: Install surface-mounted hardware according to hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

H. Install perimeter joint sealants as specified in Section 07 92 00 "Joint Sealants." and to produce weathertight installation.

I. Erection Tolerances: Install aluminum-framed systems to comply with the following maximum tolerances:

1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.

2. Alignment:
 - a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
 - b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.
3. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch.

3.03 FIELD QUALITY CONTROL

- A. Repair or remove work where inspections indicate that it does not comply with specified requirements.
- B. Additional inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.04 ADJUSTING

- A. Entrances: Adjust operating hardware for smooth operation according to hardware manufacturers' written instructions. For doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch measured to the leading door edge.

END OF SECTION 08 42 00

SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes:
 - 1. Finish hardware including electrified hardware for doors as shown on the Drawings, indicated on schedules, and as specified herein.
 - 2. Hardware for labeled openings shall meet UL requirements whether specified herein or not.
 - 3. All hardware on accessible doors shall meet or exceed the requirements of the Americans with Disabilities Act (ADA) whether or not full compliance is indicated in the Hardware Schedule located at the end of this Section.
- B. Related Sections include the following:
 - 1. Division 6 Section "Rough Carpentry" for rough hardware related to carpentry.
 - 2. Division 6 Section "Finish Carpentry" for hardware related to cabinets.
 - 3. Division 8 Section "Steel Doors and Frames" for Steel doors to receive door hardware.
 - 4. Division 8 Section "Aluminum Entrances and Storefronts" for aluminum entrance hardware.

1.03 QUALITY ASSURANCE

- A. Code Compliance: Total installation must comply with the requirements of the Florida Building Code, current edition in force, including Test Protocols for High Velocity Hurricane Zones.
- B. Approved Products: As applicable, products used herein shall comply with requirements of the Florida Product Approval System as required by Florida Statute 553.842 and Florida Administrative Code 9B-72.
- C. Reference Standards: Comply with provisions of the latest adopted editions of the following:
 - 1. Door and Hardware Institute (DHI):
 - a. Referenced Standards.
 - 2. National Fire Protection Association (NFPA):
 - a. NFPA 80 Fire Doors and Fire Windows.

b. NFPA 101 Life Safety Code.

- B. Installer Qualifications: An experienced installer who has completed finish 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.

1.04 SUPPLIER QUALIFICATIONS

- A. Finish Hardware shall be furnished by one supplier, approved by the Architect/Engineer, with appropriate technical knowledge and experience to correctly interpret Drawings and Specifications. Supplier shall be prepared at all times during progress of installation to promptly provide a qualified Architectural Hardware Consultant (AHC) to approve its complete installation, in order that all items shall be installed in the best manner and function properly. This will necessitate a project site visit prior to final inspection. Supplier shall be bona-fide direct distributor of all materials furnished.
- B. It shall be the supplier's responsibility to furnish hardware in accordance with the intent of this specification. Where, by virtue of architectural design or by function, a change is necessary, hardware of equal design and quality shall be furnished upon written approval of Architect/Engineer.

1.05 SUBMITTALS

- A. Product Data: Submit complete product data for each item of finish hardware listed in the Finish Hardware Schedule. Include installation details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Finish Hardware Schedule: Submit complete typewritten sets of the Finish Hardware Schedule. Organize the Hardware Schedule into door hardware sets indicating complete designations of every item required for each door. Organize door hardware sets in the same order as in Article 3.03 - FINISH HARDWARE SCHEDULE. No factory order shall be placed for finish hardware items until approval has been given by the Architect/Engineer.
1. Each item in the Finish Hardware Schedule shall be identified on the first page of the Schedule by the manufacturer's name.
- C. Keying Schedule: Submit a keying schedule prepared by the supplier, detailing the Owner's keying instructions for locks. Include a schematic keying diagram and index each key to unique door designations. Refer to keying schedule at the end of this Section for additional information.
- D. Supplier Qualifications:
1. Submit documented evidence of supplier's qualifications.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. All items of finish hardware shall be delivered to the Project site, or as otherwise specified or required, and shall be checked in for completeness and familiarization with

the Contractor.

- B. All items of finish hardware shall be packaged, numbered, and labeled to identify each opening for which it is intended, and to correspond with item numbers on the approved Finish Hardware Schedule.

1.08 COORDINATION

- A. Templates: All finish hardware to be installed on, or in metal doors and/or frames, shall be manufactured to template. Template machine screws shall be furnished for all such materials. Supplier shall furnish an approved Finish Hardware Schedule and all necessary template transmittals to metal frame fabricators, or other suppliers requiring same, for their coordination and use.

PART 2 - PRODUCTS

2.01 GENERAL

- A. An asterisk (*) after a manufacturer's name denotes whose product designation is used in the Finish Hardware Schedule for purposes of establishing minimum requirements.
- B. Other than those doors that are restricted to less than 180 degree opening by building or by overhead holders or stops, all butts and closer arms shall be of sufficient size to allow full 180-degree opening of doors.

2.02 FINISHES

- A. Butts - Exterior: US32D
- B. Butts - Interior: US26D
- C. Locks: US32D
- D. Closers: SBL
- E. Door Stops and Miscellaneous: US26D

2.03 LOCATIONS

- A. Hardware locations dimension shall be as follows:
 - 1. Distance from finish floor to center line of:
 - a. Door Knob or Lever: 38 inches.
 - b. Door Pull: 42 inches.
 - c. Deadlock: 60 inches.
 - 2. Butt Hinges:
 - a. Bottom Hinge: Finish floor to bottom of hinge 10 inches.

- b. Top Hinge: Head rabbet to top of hinge 5 inches.
- c. Center Hinge: Equidistant between top and bottom hinges.

2.04 BUTT HINGES

- A. Doors (1-3/4 Inch Thick): Minimum 4-1/2 inches high.
- B. Each door shall not have less than three hinges.
- C. All butts used with door closers shall be ball bearing. All exterior doors shall have ball bearing butts, except as otherwise specified.
- D. All exterior out-swinging doors shall have butts with non-removable pins (NRP).
- E. Products: Provide butt hinges by one of the following manufacturers:
 - 1. Hager Companies.*
 - 2. Stanley Commercial Hardware Div. of The Stanley Works.
 - 3. McKinney Products Co. Div. of ESSEX Industries, Inc.
 - 4. Lawrence Brothers, Inc.
 - 5. Or Approved Equal

2.05 LOCKSETS

- A. Locksets shall be mortised type with interchangeable core furnished in the functions as specified in the hardware sets.
- B. Levers, escutcheons, locksets and cylinders shall be the products of one manufacturer.
- C. Minimum wall thickness of levers and roses shall be .101 inch and .099 inch, respectively.
- D. All latch bolts shall have 3/4 inch throw. All deadbolts shall have hardened steel inserts and 1 inch throw.
- E. Products: Provide one of the following:
 - 1. **Basis of Design: Von Duprin 7500 & E-7500 Series US32D lockset and “LWA” handle design, or approved equal.**

2.06 EXIT DEVICES

- A. All exit devices shall be listed under “Panic Hardware” in accident equipment list of Underwriters’ Laboratories (UL).
- B. All labeled doors with “Fire Exit Hardware” shall have labels attached and be in strict accordance with UL requirements.
- C. All exit devices shall be tested to ANSI/BHMA A156.3 test requirements by a BHMA

certified testing laboratory. A written certification showing successful completion of a minimum of 1,000,000 cycles shall be provided.

- D. Electrified-controlled exit devices shall be UL Listed.
- E. All surface strikes shall be roller type and come complete with a plate underneath to prevent movement, and shall be provided with a dead-latching feature to prevent latchbolt tampering.
- F. Products: Provide one of the following:
 - 1. Basis of Design: Von Duprin 98/99 Series, or approved equal, for mortised installation with interchangeable core, as applicable, in types and functions specified. Provide CXA-98 Series for electrified exit devices.

2.07 KEYING/KEY CONTROL SYSTEM

- A. Keying: All locks shall be Master Keyed as indicated.

2.08 CLOSERS

- A. Closers shall be provided in the manufacturer's recommended printed size for specified installation condition, unless otherwise noted in the Finish Hardware Schedule.
- B. Closers shall be full rack and pinion complete with back check. Springs shall be motor clock type. Furnish flush mount transom brackets where no transom bar exists. Furnish parallel arm where required.
- C. All closers shall be provided with limited opening resistance to meet handicap requirements.
- D. Furnish drop plate brackets where required.
- E. Closer at exterior doors shall be installed on the inside of the building.
- F. Products: Provide one of the following:
 - 1. "Series 1430" exterior and "Series 1431" interior closers; Sargent Manufacturing Company Div. of ESSEX Industries, Inc.*
 - 2. "Series 8501"; Norton Door Controls Div. of Yale Security Inc.
 - 3. An equivalent product by one of the following manufacturers:
 - a. LCN Closers, An Ingersoll-Rand Company.

2.09 DOOR STOPS

- A. Products: Provide door stop types as follows:
 - 1. Products by H.B. Ives:
 - a. Wall: "No. 407-1/2."

- b. Floor: "No. 436."
 - c. Floor at Door with Threshold: "No. 438."
 - 2. Products by Rockwood Manufacturing Company:
 - a. Wall: "No. 409."
 - b. Floor: "No. 441."
 - c. Floor at Door with Threshold: "No. 443."
- B. Other Products: Equivalent products by one of the following manufacturers are also acceptable:
 - 1. Glynn-Johnson, An Ingersoll-Rand Company.

2.10 SILENCERS

- A. All interior metal door frames shall have door silencers, three (3) per single door, six (6) per pair of doors.
- B. Products: Provide one of the following silencer types:
 - 1. "Type 20"; H.B. Ives.*
 - 2. "Type 64"; Glynn-Johnson, An Ingersoll-Rand Company.
 - 3. "No. 608"; Rockwood Manufacturing Company.

2.11 WEATHERSTRIPPING

- A. General: Continuous weatherstripping shall be installed at each edge of every exterior door leaf. Provide non-corrosive fasteners as recommended by manufacturer for application indicated. Include door top protection (drip caps) for exterior doors where scheduled or as required.
- B. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strip is easily replaceable and readily available from stocks maintained by manufacturer.
- C. Weatherstripping at Jambs and Heads: Bumper-type resilient insert and metal retainer strips, surface-applied. Extruded aluminum retainer, natural anodized finish; closed cell EPDM sponge neoprene insert, except vinyl insert for door shoes.
- D. Products: Provide one the following products:
 - 1. "319CR"; Pemko Manufacturing Co.*
 - 2. Other Products: Equivalent products by one of the following manufacturers are also acceptable:
 - a. Zero International, Inc.

- b. Reese Enterprises, Inc.

2.12 THRESHOLDS AND DOOR BOTTOMS

- A. General: Extruded aluminum units, vinyl insert, of type, size and profile as shown or scheduled. Provide thresholds at labeled doors where required by Code, whether specified or not. Product to be of one of the following manufacturers or approved equal.
- B. Products, Thresholds: Provide one of the following:
 - 1. “272A with 282A Elevator”; Pemko Manufacturing Co., Inc.*
 - 2. Other Products: Equivalent products by one of the following manufacturers are also acceptable:
 - a. Zero International, Inc.
 - b. Reese Enterprises, Inc.
- C. Products, Door Bottoms: Provide one of the following:
 - 1. “315CN”; Pemko Manufacturing Co., Inc.*
 - 2. Other Products: Equivalent products by one of the following manufacturers are also acceptable:
 - a. Zero International, Inc.
 - b. Reese Enterprises, Inc.

2.13 DRIP CAPS

- A. Install on all exterior doors not under cover as scheduled.
- B. Products: Provide one of the following:
 - 1. “346 AL”; Pemko Manufacturing Co., Inc.*
 - 2. Other Products: Equivalent products by one of the following manufacturers are also acceptable:
 - a. Zero International, Inc.
 - b. Reese Enterprises, Inc.

2.14 FASTENERS

- A. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to commercially recognized industry standards for application intended. Provide Phillips flat-head screws with finished heads to match surface of door hardware.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine doors and frames, 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. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Preparation: Comply with the following:
 - 1. Steel Doors and Frames: Comply with Door and Hardware Institute (DHI) A115 Series, "Specifications for Steel Door and Frame Preparation for Hardware (ANSI)."
- B. Mount hardware units at heights indicated in the following applicable publications, except as specifically listed herein under Article 2.03 LOCATIONS, and/or otherwise directed by the Architect/Engineer and required to comply with governing regulations.
 - 1. Steel Doors and Frames: Comply with DHI "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
- C. Install each hardware item in compliance with the manufacturer's published instructions and current recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and re-installation or application of surface protection with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on the substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
 - 3. Re-install designated hardware for doors indicated on Drawings. Repair and/or replace hardware as required to provide a complete operable, secure closure.
- D. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant.
- E. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.

- F. Coordinate with electrical installer for connections for power actuated hardware devices.
- G. Clean adjacent surfaces soiled by hardware installation. Clean operating items as necessary to restore proper function and finish.

3.03 FINISH HARDWARE SCHEDULE

- A. The following hardware set(s) are based on door location types as indicated. Refer to Drawings for specific door numbers, sizes, types, and swings.

ALUMINUM ENTRANCE DOORS

Aluminum Entrance Doors and Frames – Refer to Section 08 42 00 – ALUMINUM ENTRANCES AND STOREFRONTS.

DOOR 108, 120, 120A		AL x AL	Swing as Indicated
Hinges:	1-1/2 pr	Hager BB1191 4-1/2 x 4-1/2 NRP US32D	
Electrified Exit Device:	1	Von Durpin Delayed Egress E-7500 Series with 08 Outside Lever Trim, Mortise Installation with Electric Latch activated by Card Reader on Inside and out - Removable Core Cylinder (Match Owner's Existing Core - Schlage) US32D	
Power Supply	1	Von Durpin PS914 4 Amp @ 24 VDC per device	
Card Readers:	2	Refer to Division 28 Electric Safety & Security	
Power Transfer:	1	Von Duprin EPT10 US32D	
Closer:	1	LCN 4050 Series PA Full Cover SBL	
Threshold	1	Pemko 272A AL	
Door Bottom	1	Pemko 315CN AL	
Weatherstripping	1 Set	Pemko 319CR AL	

STEEL DOORS

Steel Doors and Frames – Refer to Section 08 11 13 – STEEL DOORS AND FRAMES.

DOOR 101B, 122		MD x MF	Swing as Indicated
Hinges:	1-1/2 pr	Hager BB1191 4-1/2 x 4-1/2 NRP US32D	
Electrified Exit Device:	1	Von Durpin Delayed Egress E-7500 Series with 08 Outside Lever Trim, Mortise Installation - Removable Core Cylinder (Match Owner's Existing Core - Schlage) US32D	
Closer:	1	LCN 4050 Series Full Cover SBL	
Door Stop:	1	Ives 407-1/2	
Threshold	1	Pemko 272A AL	
Door Bottom	1	Pemko 315CN AL	

DOORS 107B, 107C		MD x MF	Swing as Indicated

Hinges:	1-1/2 pr	Hager BB1191 4-1/2 x 4-1/2 US32D
Electrified Exit Device:	1	Von Durpin Delayed Egress E-7500 Series with 08 Outside Lever Trim, Mortise Installation with Electric Latch activated by Card Reader - Removable Core Cylinder (Match Owner's Existing Core - Schlage) US32D
Power Supply	1	Von Durpin PS914 4 Amp @ 24 VDC per device
Card Readers:	2	Refer to Division 28 Electric Safety & Security
Power Transfer:	1	Von Duprin EPT10 US32D
Closer:	1	LCN 4050 Series Full Cover SBL
Threshold	1	Pemko 272A AL
Door Bottom	1	Pemko 315CN AL
Weatherstripping	1 Set	Pemko 319CR AL
Drip Cap	1	Pemko 346 AL

DOORS 111, 127

MD x MF Swing as Indicated

Hinges:	1-1/2 pr	Hager BB1191 4-1/2 x 4-1/2 US32D
Mortise Lockset:	1	Schlage L Series Grade 1 US32D (F07 Storeroom)
Door Stop:	1	Ives 407-1/2

(PR)DOOR 110

MD x MF Swing as Indicated

Hinges:	3 pr	Hager BB1191 4-1/2 x 4-1/2 US32D
Electrified Exit Device:	1	Von Durpin Delayed Egress E-7500 Series with 08 Outside Lever Trim, Mortise Installation - Removable Core Cylinder (Match Owner's Existing Core - Schlage) US32D
Closer:	2	LCN 4050 Series Full Cover SBL
Door Stop:	2	Ives 407-1/2

DOOR 113

Overhead Coiling Door

Refer to Section 08 33 23 – OVERHEAD COILING DOORS

Card Readers:	2	Refer to Division 28 Electric Safety & Security

(PR) DOORS 113A, 119

MD x MF Swing as Indicated

Hinges:	3 pr	Hager BB1191 4-1/2 x 4-1/2 NRP US32D
Electrified Exit Device:	1	Von Durpin Delayed Egress E-7500 Series with 08 Outside Lever Trim, Mortise Installation - Removable Core Cylinder (Match Owner's Existing Core - Schlage) US32D
Flush Bolts	2	Ives 12" – Inactive Leaf
Closer:	1	LCN 4050 Series PA Full Cover SBL
Door Stop:	1	Ives 407-1/2

Threshold	1	Pemko 272A AL
Door Bottom	2	Pemko 315CN AL
Weatherstripping	1 Set	Pemko 319CR AL
Drip Cap	1	Pemko 346 AL

(PR) DOOR 113B

MD x MF Swing as Indicated

Hinges:	3 pr	Hager BB1191 4-1/2 x 4-1/2 NRP US32D
Electrified Mortise Lockset:	1	Von Duprin E-7500 Series - Mortise Installation with Electric Latch activated by Card Reader Inside and Out - Removable Core Cylinder (Match Owner's Existing Core - Schlage) US32D
Power Supply	1	Von Durprin PS914 4 Amp @ 24 VDC per device
Card Reader:	2	Refer to Division 28 Electric Safety & Security
Power Transfer:	1	Von Duprin EPT10 US32D
Closer:	1	LCN 4050 Series Full Cover SBL
Door Stop:	1	Ives 407-1/2
Threshold	1	Pemko 272A AL
Door Bottom	1	Pemko 315CN AL

DOOR 113C

MD x MF Swing as Indicated

Hinges:	4	Hager BB1191 4-1/2 x 4-1/2 NRP US32D
Electrified Mortise Lockset:	1	Von Duprin E-7500 Series - Mortise Installation with Electric Latch activated by Card Reader Inside and Out - Removable Core Cylinder (Match Owner's Existing Core - Schlage) US32D
Power Supply	1	Von Durprin PS914 4 Amp @ 24 VDC per device
Card Reader:	2	Refer to Division 28 Electric Safety & Security
Power Transfer:	1	Von Duprin EPT10 US32D
Closer:	1	LCN 4050 Series Full Cover SBL
Door Stop:	1	Ives 407-1/2
Threshold	1	Pemko 272A AL
Door Bottom	1	Pemko 315CN AL
Weatherstripping	1 Set	Pemko 319CR AL
Drip Cap	1	Pemko 346 AL

DOOR 121

MD x MF Swing as Indicated

Hinges:	1-1/2 pr	Hager BB1191 4-1/2 x 4-1/2 NRP US32D
Electrified Exit Device:	1	Von Duprin Delayed Egress E-7500 Series with 08 Outside Lever Trim, Mortise Installation with Electric Latch activated by Card Readers Inside and Out - Removable Core Cylinder (Match Owner's Existing Core - Schlage) US32D
Power Supply	1	Von Durprin PS914 4 Amp @ 24 VDC per

Card Reader:	2	device
Power Transfer:	1	Refer to Division 28 Electric Safety & Security
Closer:	1	Von Duprin EPT10 US32D
Threshold	1	LCN 4050 Series PA Full Cover SBL
Door Bottom	1	Pemko 272A AL
Weatherstripping	1 Set	Pemko 315CN AL
Door Holder:	1	Pemko 319CR AL
		Ives FS446 Holder – Surface Mounted – Aluminum Finish (180B)

DOORS 114

MD x MF Swing as Indicated

Hinges:	1-1/2 pr	Hager BB1191 4-1/2 x 4-1/2 US32D
Mortise Privacy Latchset:	1	Schlage L Series Grade 1 US32D (F05 Classroom)
Closer:	1	LCN 4050 Series Full Cover SBL
Door Stop:	1	Ives 407-1/2
Privacy Indicator Lock:	1	Pride Barco Lock K-300-V-CH

DOOR 115, 115A, 116, 117, 117A, 118 110A, 110B, 110C, 128

MD x MF Swing as Indicated

Hinges:	1-1/2 pr	Hager BB1191 4-1/2 x 4-1/2 US32D
Mortise Lockset:	1	Schlage L Series Grade 1 US32D (F05 Classroom)
Closer:	1	LCN 4050 Series Full Cover SBL
Door Stop:	1	Ives 407-1/2

DOOR 130

MD x MF Swing as Indicated

Hinges:	1-1/2 pr	Hager BB1191 4-1/2 x 4-1/2 NRP US32D
Mortise Lockset:	1	Von Duprin 7500 Series US32D (F05 Function) - Removable Core Cylinder (Match Owner's Existing Core - Schlage) US32D
Closer:	1	LCN 4050 Series PA Full Cover SBL
Threshold	1	Pemko 272A AL
Door Bottom	1	Pemko 315CN AL
Weatherstripping	1 Set	Pemko 319CR AL

DOOR 124

MD x MF Swing as Indicated

Hinges:	1-1/2 pr	Hager BB1191 4-1/2 x 4-1/2 NRP US32D
Electrified Mortise Lockset:	1	Von Duprin E-7500 Series - Mortise Installation with Electric Latch activated by Card Reader outside - Removable Core Cylinder (Match Owner's Existing Core - Schlage) US32D
Power Supply	1	Von Duprin PS914 4 Amp @ 24 VDC per device
Card Reader:	2	Refer to Division 28 Electric Safety & Security
Power Transfer:	1	Von Duprin EPT10 US32D

Closer: 1 LCN 4050 Series Full Cover SBL

END OF SECTION 08 71 00

SECTION 08 81 80 - GLASS AND GLAZING

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes:
 - 1. Impact resistant insulated glass and glazing required for:
 - a. Aluminum entrances and storefronts.
- B. Related Sections include the following:
 - 1. Division 7 Section "Joint Sealants" for caulking and sealing work.
 - 2. Division 8 Section "Aluminum Entrances and Storefronts for glazing occurring in aluminum entrance doors.
 - 3. Division 10 "Toilet Room Accessories" for mirrors located in toilet rooms.

1.02 DEFINITIONS

- A. "Glass" includes both primary and fabricated glass products as described in GANA "Glazing Manual."
- B. "Glazing" includes glass installation and materials used to install glass.

1.03 PERFORMANCE CRITERIA

- A. Provide glass and glazing that has been produced, fabricated, and installed to withstand normal impact loading (where applicable), without failure of sealants or gaskets to remain airtight, deterioration of glass and glazing materials, and other defects in the work.

1.04 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide materials obtained from one source for each type of glass and glazing product indicated.
- B. Source Quality Control: All glass shall bear the manufacturer's identifying label.
- C. Safety Glazing Standard:
 - 1. Where safety glass is indicated or required by authorities having jurisdiction, provide type of products indicated which comply with ANSI Z 97.1, and testing requirements of 16 CFR Part 1201 for category II materials.
 - 2. Comply with Florida Statutes - Chapter 553, Part III, Safety Performance Specifications and Methods of Test for Safety Glazing Used in Buildings.
 - 3. Subject to compliance with requirements, provide safety glass permanently marked with certification label of Safety Glass Certification Council (SGCC) or other certification agency acceptable to authorities having jurisdiction.
- D. Reference Standards: Comply with provisions of the following, unless otherwise indicated or

specified:

1. American Architectural Manufacturers Association (AAMA):
 - a. AAMA Voluntary Specifications and Test Methods for Sealants.
2. American National Standards Institute (ANSI):
 - a. ANSI Z 97.1 Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.
3. American Society for Testing and Materials (ASTM):
 - a. ASTM C 1036 Standard Specification for Flat Glass.
 - b. ASTM C 1048 Standard Specification for Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass.

1.05 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data for each glazing material and fabricated glass product required, including installation and maintenance instructions.
- B. Samples: Submit three (3) - 12 inch square samples of each type of glass scheduled for installation, and three (3) - 12 inch lengths of each type of gasket employed.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Product Delivery: Deliver glass to job site in suitable containers that will provide protection from weather and breakage.
- B. Storage and Handling: Comply with manufacturer's published directions and as required to prevent edge damage to glass and damage to glass and glazing materials from effects of moisture including condensation, of temperature changes, of direct exposure to sun, and from other causes; and keep glass free from contamination by materials capable of staining material.

1.07 PROJECT CONDITIONS

- A. Measurements: Sizes for glass shall be measured from the actual installed openings, frames, and doors.
- B. Environmental Requirements: Perform glazing when ambient temperature is above 40 degrees F., and on dry surfaces only.
- C. Sequence, Scheduling: Schedule glass deliveries to coincide with glazing schedules.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide glass products by one of the following manufacturers:
 1. Interpane Glass Company.

2. Guardian Industries.
3. PPG Industries, Inc.
4. Pilkington Libbey-Owens-Ford.
5. Viracon.

2.02 GLASS MATERIALS

A. Glass Standards:

1. Primary Glass Standard: Provide primary glass which complies with ASTM C 1036 requirements, including those indicated by reference to type, class, quality, and, if applicable; form, finish, mesh and pattern.
2. Heat-Treated Glass Standard: Provide heat-treated glass which complies with ASTM C 1048 requirements, including those indicated by reference to kind, condition, type, quality, and, if applicable; form, finish, and pattern.

B. Glass Types:

1. Clear Float Glass: Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select), 1/4 inch thick unless otherwise indicated or specified.

C. Laminated Impact Resistant Glass: Provide impact resistant laminated glass composed of the following:

1. Outboard Glass Layer: Low-E heat-treated coated tinted glass; 1/4 inch thick.
2. PVB/Polyester Intermediate Laminate Layer: .043 mil thick polyvinyl butyral (PVB) layer laminated to a .007 mil thick polyester layer, with an abrasion-resistant polysiloxane coating applied over the PVB layer of the film composite. The polyester layer of the film composite adhered to glass surface.
3. Inboard Glass Layer: Clear float heat-treated glass, 1/4 inch thick.

D. Insulating Glass Unit Assemblies:

1. Exterior Lite: 1/4 inch.
2. Air Space: 1/2 inch.
3. Interior Lite: Laminated Impact Resistant Glass (2.02, Paragraph C., above).

2.03 GLAZING MATERIALS

A. General: Comply with recommendations of sealant and glass manufacturers for selection of glazing materials which have performance characteristics suitable for applications indicated and conditions at time of installation.

1. Select glazing materials with proven compatibility with surfaces contacted in the installation and under service conditions indicated, as demonstrated by testing and field experience.

B. Glazing Sealants:

1. Silicone Glazing Sealant: Single component elastomeric silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25.
 2. Colors: Provide color of exposed sealants as selected by Architect/Engineer from manufacturer's standard colors.
 3. Products: Provide one of the following glazing sealants:
 - a. "Chem-Calk 1000"; Bostik.
 - b. "Dow Corning 790"; Dow Corning Corp.
 - c. "Silglaze 2800"; GE Silicones.
 - d. "Silpruf"; GE Silicones.
 - e. "864"; Pecora Corp.
 - f. "Omniseal"; Sonneborn Building Products Div. of Chemrex, Inc.
- C. Preformed Butyl-Polyisobutylene Glazing Tape:
1. Blend of butyl polyisobutylene rubber with a solid content of 100 percent, in extruded tape form, complying with AAMA 807.3, packaged on rolls with a release paper on side, with or without continuous spacer rod as recommended by manufacturers of tapes and glass for application indicated.
 2. Products: Provide one of the following glazing tapes:
 - a. "PTI 606"; H.B. Fuller Company.
 - b. "PTI 303"; H.B. Fuller Company.
 - c. "Tremco 440 Tape"; Tremco, Inc.
 - d. "MBT-35"; Tremco, Inc.
 - e. "Extru-Seal"; Pecora Corp.
- D. Glazing Gaskets:
1. Dense Elastomeric Compression Seal Gaskets: Molded or extruded neoprene or EPDM gaskets of profile and hardness required to maintain watertight seal; complying with ASTM C 864, Option 1.
 2. Cellular Elastomeric Preformed Gaskets: Extruded or molded closed cell, integral-skinned neoprene of profile and hardness required to maintain watertight seal; complying with ASTM C 509, Type II; black.
 3. Products: Provide gaskets by one of the following manufacturers:
 - a. D.S. Brown Co.
 - b. Maloney Precision Products Co.
 - c. Tremco Inc.
- E. Setting Blocks: Neoprene, EPDM, or silicone blocks are required for compatibility with glazing

sealants, 80 to 90 Shore A durometer hardness.

- F. Spacers: Neoprene, EPDM or silicone blocks, or continuous extrusions, as required for compatibility with glazing sealant, of size, shape, and hardness recommended by glass and sealant manufacturers for application indicated.
- G. Edge Blocks: Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealant, of size and hardness required to limit lateral movement (side-walking) of glass.
- H. Cleaners, Primers, and Sealers: Type recommended by sealant or gasket manufacturer.

2.05 FABRICATION

- A. Sizes: Fabricate glass and glazing material to sizes required for glazing openings indicated, with edge clearances and tolerances complying with recommendations of glass manufacturer. Provide thicknesses indicated or, if not otherwise indicated, as recommended by glass manufacturer for application indicated.
- B. Tong Marks: Provide tempered glass produced by manufacturer's special process which eliminates tong marks, for locations and installation condition where tong marks would otherwise be exposed. No exposed tong marks shall be permitted.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine framing glazing, with Installer present, for compliance with the following:
- B. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
- C. Presence and functioning of weep system.
- D. Minimum required face or edge clearances.
- E. Effective sealing between joints of glass framing members.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.03 INSTALLATION

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Where "Heat Treated" glass is noted, it shall be Heat Strengthened except where "Fully Tempered" is required at doors, adjacent sidelights, and other areas as required by Florida Building Code.
- C. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum

edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

- D. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- E. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

3.04 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.
- C. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION 08 81 80

DIVISION 09

SECTION 09 22 00 - PORTLAND CEMENT STUCCO

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes:
 - 1. Portland cement stucco and related accessories.
- B. Related Sections include the following:
 - 1. Division 4 Section "Unit Masonry" for masonry work.
 - 2. Division 9 Section "Painting" for painting stucco.

1.02 DESIGN CRITERIA

- A. Allowable Tolerances: For flat surfaces, do not exceed 1/4-inch in 8 feet for bow or warp of surface, and for plumb and/or level.

1.03 QUALITY ASSURANCE

- A. Reference Standards: Comply with provisions of the following, unless otherwise indicated or specified:
 - 1. American Society for Testing and Materials (ASTM):
 - a. Referenced Standards.
 - 2. Portland Cement Association (PCA):
 - a. PCA "Plasterer's Manual."

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's product specifications and installation instructions for each product, including data showing compliance with specification requirements.
- B. Samples: Submit three (3) samples on cement board backing indicative of proposed finish. Approved samples shall become the basis of comparison for all stucco work.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. All manufactured materials shall be delivered in the original packages, containers, or cartons, bearing the brand name and manufacturer's identification, and stored in a dry space, protected from the elements and from damage to containers.

1.06 PROJECT CONDITIONS

- A. Protection of Surfaces:
 - 1. Use all means necessary to protect the stucco work and materials of this Section before, during and after installation; and to protect the work and materials of other trades from moisture deterioration and soiling that may occur from stucco operations.

2. Provide temporary covering or other provisions as may be necessary to minimize harmful spattering of stucco on other work.
 3. Do not apply stucco immediately before or during a rainstorm.
- B. Environmental Conditions:
1. Warm Weather Requirements: Protect stucco against uneven and excessive evaporation and from strong flows of dry air, both natural and artificial.
 2. Cold Weather Requirements: Enclosures shall be provided in cold weather to allow uniform temperature range of 50 degrees F to 70 degrees F to be maintained.

PART 2 - PRODUCTS

2.01 STUCCO MATERIALS

- A. General: Except as otherwise indicated, provide standard products recommended by the manufacturer for the application indicated, complying with ASTM C926.
- B. Portland Cement: Provide portland cement complying with ASTM C150, Type I; and from one source to ensure uniformity in the work. Approved types of plasticity agents may be added to portland cement in the manufacturing process or when mixing; however, in no case shall the amount of plasticity agent exceed 10 percent of the volume of cement in the stucco mix.
- C. Lime: Provide dry hydrated lime, complying with ASTM C206, Type S.
- D. Aggregates: Provide aggregates complying with ASTM C897.
- E. Water: Provide clean water, free from injurious amounts of oils, acids, alkalis, salts, organic materials, or substances that may be deleterious to the stucco or metal accessories.
- F. Integral Waterproofer: Provide manufactured product that is composed of stearate water repellents and other chemicals which, when used as an admixture, form an internal barrier against water penetration. The admixture shall increase the plasticity of the stucco, reduce water absorption and guard against freeze-thaw damage. Admixture can be supplied in either a powdered form without chlorides or in a liquid formula which contain chlorides for additional densification and acceleration of the stucco. Admixture shall not increase the air content of stucco.
- G. Bonding Agents (If Indicated or Required): Bonding agents, integral or surface-applied, shall be used in accordance with the manufacturer's published instructions.
- H. Plastic Accessories: Manufactured from high-impact PVC.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Alabama Metal Industries Company; a Gibraltar Industries company.
 - b. Phillips Manufacturing Co.
 - c. Plastic Components, Inc.
 2. Cornerbeads: With perforated flanges. Smallnose cornerbead; use unless otherwise indicated.

3. Casing Beads: With perforated flanges in depth required to suit plaster bases indicated and flange length required to suit applications indicated. Bullnose style, radius 3/4-inch minimum; use at locations indicated on Drawings.
4. Control Joints: One-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
5. Expansion Joints: Two-piece type, formed to produce slip-joint and square-edged 1/2-inch wide reveal; with perforated concealed flanges.

2.02 MIXING AND PROPORTIONING STUCCO

- A. All stucco mix ingredients shall be mixed in a mechanical mixer with the minimum amount of water needed to produce stucco of workable consistency. Stucco shall be mixed for a minimum of 2 minutes or until all ingredients are uniform in color after all ingredients are in the mixer.
- B. Stucco ingredients shall be mixed in the following proportions:
 1. Three (3) Coat Application:

Coat	Portland Cement	Lime by Volume	Aggregates by Volume	Integral Waterproofer
1st (base)	1	---	3-1/2	---
2nd (brown)	1	15% max.	2	1 qt. per bag of cement
3rd (finish)	1	15% max.	2	1 qt. per bag of cement

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine the areas and conditions under which this Work is to be performed. Correct conditions detrimental to the proper and timely completion of this Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Prior to application, ensure mechanical and electrical services behind surfaces to receive stucco have been tested and approved.
- B. Place accessories true to lines and levels, neatly butted at joints and intersections. Use longest pieces available; multiple short sections are not acceptable.
- C. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.
- D. Prepare solid substrates for plaster that are smooth or that do not have the suction capability required to bond with plaster according to ASTM C 926.

3.03 STUCCO APPLICATION

A. General:

1. Stucco application shall be performed by skilled mechanics experienced in this type of work. All work shall be properly rodged true and straight, flush with grounds applied in strict accordance with ASTM C 926 and with the recommendations of the PCA "Plasterer's Manual," unless otherwise indicated.
2. Do not use materials which are caked or lumpy, or which are dirty or contaminated by foreign materials. Use only clean water, free from impurities that might impair the work; do not use water that has been used to clean tools. Do not use excessive water in the mixing and application of stucco materials.
3. Sequence stucco applications with other work in accordance with recognized industry standards. Delay application of finish coat until adjoining work has been completed, wherever possible.
4. Screed stucco work at all angles, arises, corners, and every 8 feet on surfaces. Place screeds to true grounds; scrape screeds and grounds clean. All finished surfaces shall be straight, true, and plumb. Form corners, angles, and intersections accurately, in perfect line, every angle true and full.

B. Thickness:

1. Stucco shall be applied in thicknesses as follows:

Stucco Base	First (Base) Coat	Second (Brown) Coat	Third (Finish) Coat	Total Thickness
Masonry	1/4"	1/4"	1/8"	5/8"

C. Methods:

1. First (Base) Coat: Apply first (base) coat to masonry with sufficient pressure to form a good key. Bring to plumb, true, even surface, rough in texture. When sufficiently set, float scratch with dry float. Cross scratch evenly to form bond for second (brown) coat.
2. Second (Brown) Coat: Apply second (brown) coat as soon as first (base) coat has set sufficiently to carry the weight (approximately 3 hours). Float or rod to true, even surface and keep moist until application of third (finish) coat.
3. Third (Finish) Coat: Apply third (finish) coat as soon as possible after brown coat hardens; usually the next morning. Use float for preliminary finishing then steel trowel for final compacting. Finish shall be as selected and approved by the Owner and/or Architect/Engineer.
 - a. Finish coat to be painted as specified under Section 09 91 00 "Painting."

D. Curing: Damp cure stucco as follows:

1. Surfaces shall be protected from the sun, hot-dry winds, or excessive ventilation using canvas, cloth, or plywood barriers; then kept moist with a fog spray of water until proper hydration takes place; usually 48 hours for temperatures ranging 50 degrees F and above. Alligatoring and multiple shrinkage cracks will be cause for replacement of material.

2. Do not damage finished surface by water erosion during damp curing operation.

3.04 INSTALLING ACCESSORIES

- A. Install according to ASTM C1063 and at locations indicated on Drawings.
- B. Reinforcement for External (Outside) Corners: Install cornerbead at exterior locations.
- C. Control Joints: Locate as approved by Architect/Engineer for visual effect and as follows:
 1. As required to delineate plasterwork into areas (panels) of the following maximum sizes:
 - a. Vertical Surfaces: 144 sq. ft.
 - b. Horizontal and Other Non-vertical Surfaces: 100 sq. ft.
 2. At distances between control joints of not greater than 18 feet o.c.
 3. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.
 4. Where control joints occur in surface of construction directly behind plaster.
 5. Where plasterwork areas change dimensions, to delineate rectangular-shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.

3.04 CUTTING AND PATCHING

- A. Cut, patch, repair and point-up stucco as required and as necessary to accommodate other work. Repair cracks and indented surfaces. Point-up finish stucco surfaces around items that are built into or penetrate stucco surfaces. Repair or replace stucco work to eliminate blisters, buckles, check cracking, dry outs, efflorescence, excessive pinholes, and similar imperfections. Repair or replace the work as necessary to comply with specified tolerances and required visual effects.

3.05 PROTECTION

- A. Remove temporary covering and other provisions made to minimize splattering of stucco on other work. Repair surfaces that have been stained, marred or otherwise damaged during stucco work.

END OF SECTION 09 22 00

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SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes:
 - 1. Gypsum board and accessories as indicated on the Plans and specified herein.
- B. Related Sections include the following:
 - 1. Division 4 Section "Unit Masonry" for masonry work.
 - 2. Division 5 Section "Cold-Formed Metal Framing" for wall and ceiling framework.
 - 3. Division 7 Section "Joint Sealants" for sealants and caulking.
 - 4. Division 9 Section "Painting" for painting gypsum wallboard.

1.02 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance-Rated Assemblies: Indicated by designations from UL's "Fire Resistance Directory," unless otherwise indicated.
- B. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.
 - 1. STC-Rated Assemblies: Indicated by design designations from Gypsum Association's GA-600 "Fire-Resistance Design Manual," unless otherwise indicated.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's technical information and installation instructions for each manufactured product.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

1.05 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or blotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.01 METAL SUPPORT MATERIALS

- A. General: Comply with ASTM C 754 for conditions indicated.
- B. Steel Framing and Furring: Specified in Section 05 40 00 – COLD FORMED METAL FRAMING.
- C. Fasteners: Type and size recommended by the manufacturer for the substrate and application as indicated. Comply with ASTM C 1002.
 - 1. Screws attaching gypsum board to metal studs shall be corrosion resistant No. 6 Phillips, bugle head drywall screws designed for fastening to metal, sized to be 3/8 inch longer than total thickness of gypsum board and metal studs.

2.02 INTERIOR GYPSUM BOARD

- A. Gypsum board shall be 5/8 inch panel thickness, tapered long edges, Type X where indicated or required for fire-resistance-rated assembly conforming to ASTM C 36 as follows:
 - 1. Gypsum wallboard; G-P Gypsum Corp.
 - 2. Gypsum wallboard; National Gypsum Company.
 - 3. Gypsum wallboard; United States Gypsum Co.
 - 4. Or approved equal.
- B. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
- C. Water and Mold-Resistant Type: Provide where indicated and/or required in toilet rooms, janitor's closet, and other "wet" areas. Comply with ASTM C 630.

2.03 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

- A. Exterior Gypsum Soffit Board shall be 5/8 inch panel thickness, tapered long edges, Type X where indicated or required for fire-resistance-rated assembly conforming to ASTM C 1396/C 1396M as follows:
 - 1. Gypsum wallboard; G-P Gypsum Corp.
 - 2. Gypsum wallboard; National Gypsum Company.
 - 3. Gypsum wallboard; United States Gypsum Co.

- 4. Or approved equal.
- B. Glass-Mat Gypsum Sheathing Board shall be 5/8 inch panel thickness, ASTM C 1177/C 1177M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.
- C. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

2.03 TRIM ACCESSORIES

- A. Interior Trim: Comply with ASTM C 1047.
- B. Material: Solid zinc.
- C. Casing Beads (J-Beads): Type for securing through face of tapered edge, and embedding and taping to conceal surface flange. U-moldings and channel-shaped plaster/stucco type casing beads are NOT acceptable.
 - 1. Products: Provide one of the following:
 - a. D-200 Series L Bead; Dale Industries, Inc.
 - b. No. 200 Wallboard Casing; National Gypsum Company.
 - c. Sheetrock 200 Series; United States Gypsum Co.
 - d. Or approved equal.
- D. Corner Beads: Standard type zinc with perforated surface flanges to be attached through each gypsum face and concealed by embedding, of sizes for pertinent application.
 - 1. Products: Provide one of the following:
 - a. Drywall Corner Bead; Dale Industries, Inc.
 - b. Gold Bond Wallboard Cornerbead; National Gypsum Company.
 - c. Dur-a-Bead Corner Bead; United States Gypsum Co.
 - d. Or approved equal.
- E. Control Joints: One-piece, formed with vee-shaped slot per Figure 1 in ASTM C 1047, with slot opening covered with removable strip.

2.04 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475.
- B. Joint Tape: Paper, except as recommended by panel manufacturer for tile backing panels.
- C. Joint Compound: Adhesive, with or without fillers. Provide in dry powder form or pre-mixed ready for application as follows:
 - 1. Two-Compound Treatment: Provide manufacturer's compatible single-component setting-type and drying-type compounds; one compound for bedding and another

finishing joints.

- D. Prefilling: At open joints and damaged surface areas use setting-type taping compound.
- E. Joint Compound for Exterior Applications:
 - 1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
 - 2. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine the areas and conditions under which the gypsum board is to be installed. Do not proceed with gypsum wallboard work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF STEEL FRAMING

- A. Refer to Section 05 40 00 – COLD FORMING METAL FRAMING for installation of steel framing. Comply with ASTM C 754 and ASTM C 840 requirements that apply to framing installation.

3.03 INSTALLATION OF GYPSUM WALLBOARD

- A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.
- B. Install gypsum panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- C. Locate edge and end joints over supports. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- D. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- E. Attach gypsum panels to framing provided at openings and cutouts.
- F. Form control and expansion joints with space between edges of adjoining gypsum panels.
- G. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
- H. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch wide spaces at these locations, and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

- I. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.
 - 1. Space screws a maximum of 12 inches o.c. for vertical applications.

3.03 PANEL APPLICATION METHODS

- A. Single-Layer Application:
 - A. On partitions/walls, apply gypsum panels vertically parallel to framing, unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of board.
- B. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.04 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Engineer for visual effect.

3.05 FINISHING GYPSUM BOARD ASSEMBLIES

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:
 - 1. Level 1: Embed tape at joints, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
 - a. Locations: Ceiling plenum areas, concealed areas.
 - 2. Level 2: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges.
 - a. Locations: Backing board where appearance is not of primary concern.
 - 3. Level 3: Embed tape and apply separate first and fill coats of joint compound to tape, fasteners, and trim flanges.
 - a. Locations: Areas that are to receive heavy texture (spray or hand applied) finish before painting.
 - 4. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view.

- a. Locations: Areas where wallcoverings, flat and satin paints, or light textures are indicated.
- 5. Level 5: Equal to Level 4, and in addition, a skim coat shall be applied. Excess material shall be immediately sheared off, leaving a film covering the paper.
 - a. Locations: Areas where glossy (epoxy) paints are applied or where severe lighting occurs.

END OF SECTION 09 29 00

SECTION 09 51 00 - ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes:
 - 1. Acoustical ceiling panels, suspension system, related trim and installation accessories.
- B. Related Sections include the following:
 - 1. Division 9 Section "Gypsum Wallboard" for drywall ceilings.
- C. Review Architectural, Mechanical and Electrical Drawings for layout, location, and pattern of acoustical panels, location of recessed light fixtures, ceiling diffusers, and grilles, details of suspension system, details of change of level, details at ceiling penetrations, access door locations, special edge treatment, and all necessary connections to work of other trades.

1.02 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installation shall be performed only by a qualified installer with at least five (5) years' documented experience in installations of a similar nature, and as approved by the manufacturer and Architect/Engineer.
- B. Design Criteria:
 - 1. All finish materials specified under this Section shall have a minimum Class A flame spread rating of 25 or less when tested in accordance with ASTM E84.
 - 2. The Acoustical grid system shall conform to structural classifications of ASTM C635, and those established by the Ceiling and Interior Systems Construction Association (CISCA).

1.03 SUBMITTALS

- A. Product Data:
 - 1. Submit product data for each type of product specified.
- B. Shop Drawings:
 - 1. Submit complete shop drawings. Shop drawings shall indicate sizes and layout of ceiling panels and suspension system component details. Manufacturer's names and product data shall be clearly indicated on all shop drawings.
- C. Samples:
 - 1. Submit three (3) full-size samples of each kind of acoustical material proposed for use including suspension system. Each sample shall bear a label indicating the type, quality, and color of the material, and shall bear the manufacturer's name.
- D. Installer Qualifications:

1. Submit documented evidence of installer's qualifications.

1.04 PRODUCT, DELIVERY, STORAGE AND HANDLING

- A. The materials shall be delivered to the Site in the manufacturer's original, unopened, labeled containers, or packages. Materials shall be stored in enclosed areas with same temperature and humidity conditions as areas in which materials are to be installed.
- B. All packages under this Section shall be properly marked on the outside with the identification of the material contained in the packages, so that they may be readily identified with the location to be used.

1.05 PROJECT CONDITIONS

- A. Mechanical and electrical equipment and fixture installers shall furnish all necessary supports for their materials independent of, and prior to, installation of suspended grid systems.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Acoustical Ceiling Panels:
 1. Basis of Design: Armstrong Ceiling and Wall Solutions, or approved equal, in size and edge style indicated, as follows:
 - a. Calla® Square Tegular Smooth texture.
 2. Comply with ASTM E1264.
 3. Refer to Drawings for locations.
- B. Metal Suspension System:
 1. Basis of Design: Armstrong Sonata® 9/16" Suspension System, or approved equal.
 2. Comply with ASTM C635 Intermediate-duty structural classification. Main tees and cross tees roll formed from cold-rolled steel sheet, hot-dip galvanized according to ASTM A653 (G30).
 2. Dimensions: System to consist of main tees and cross tees, built to snap together modules of 24-inch x 24-inch for installation of lay-in acoustical ceiling panels.
 3. Accessories shall be specifically designed as an integral part of the suspension system, and shall be installed in accordance with manufacturer's published recommendations.
 - a. Attachment Devices: Size for 5 times the design load indicated in ASTM C635, Table 1, "Direct Hung," unless otherwise indicated.
 - b. Wire Hangers, Braces, and Ties: Zinc-coated carbon steel wire complying with ASTM A641, Class 1 zinc coating, soft temper. Provide minimum 12 gauge diameter wire.
 - c. Metal Edge Moldings and Trim: Shall be fabricated from sheet metal of same material, finish, and color as that used for exposed flanges of tee.

4. There shall be no exposed fasteners.

2.02 FABRICATION

- A. Suspension system components shall be designed to support the ceiling assembly indicated on project Drawings with maximum deflection of $1/360$ of the span, including appropriate load-carrying capacity for acoustical panels, light fixtures, and HVAC elements, and shall be 1-1/2 inch high double-web intermediate main tees with 1-1/8 inch or 1-1/2 inch high cross tees.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine the areas and conditions under which the acoustical ceiling system is to be installed. Do not proceed with acoustical ceiling work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Installation of acoustical ceilings shall be in strict accordance with the manufacturer's published instructions, unless otherwise specified.
- B. Install acoustical ceiling panels in a true and even plane, in straight line course laid out symmetrically about center lines of ceiling or panel. Border panels shall not be less than 6 inches wide. Unless shown otherwise on reflected ceiling plan Drawings, the work shall be so laid out that border panels shall be of the same width on opposite sides and fit neatly against vertical surfaces.
- C. Suspend main tees from structure by not less than 12 gauge, galvanized wire located not over 4 feet on center, attached to the acoustical panel suspension system from the structural system above. Do not suspend grid system from metal deck, HVAC ducts, electrical conduit, or plumbing lines. Use trapeze-type hangers at HVAC ducts over 4 feet wide. Joint cross tees shall be located by routs in web of transverse cross tees. Main tees and cross tees shall rest on angle moldings at walls. Tabs of cross tees intersecting cross tees shall remain unbent.
- D. Keep finished surface of acoustical ceiling panels free of soiling and left in a condition acceptable to Owner. Replace all damaged units at no cost to Owner.
- E. All suspension grid components damaged during construction activities shall be replaced prior to panel installation.

3.03 EXTRA STOCK

- A. Furnish to the Owner prior to Final Acceptance, extra stock of acoustical materials, consisting of a minimum of 3 percent of the area of each size, type, and thickness installed on the job. Properly package, seal, and identify stock materials

END OF SECTION 09 51 00

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SECTION 09 62 00 – SPECIALTY FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Cushioned Flooring for fatigue relief of standing / walking workers.

1.2 ACTION SUBMITTALS

- A. Submit shop drawings, printed description of materials, color/treatment options, installation instructions, care guide and warranty information.
- B. Samples: For each exposed product and for each color and pattern specified with applicable accessories.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Include methods for maintaining installed products, and precautions against cleaning materials and methods detrimental to finishes and performance.
- B. Warranty: Provide manufacturer's eight (8) year limited warranty to be free from defects in material and workmanship, under normal use and service.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer with a minimum of five (5) years of fabrication and installation of cushioned flooring.
- B. Meet or exceed the Fire Rating requirements of ASTM E648.
- C. Meet or exceed the Slip Resistance requirements of ASTM C1028-96.
- D. Meet or exceed the Strength and Flexibility requirements of ASTM D412.
- E. Meet or exceed the Durometer Hardness requirements of ASTM D2240.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Provide cushioned anti-fatigue flooring manufactured by: SATECH, Inc or Approved Equal.

2.2 MATERIALS

A. Cushioned Anti-Fatigue Flooring: PLTFRM (uncovered rubber tile unless noted)

1. Color: Owner/Architect to select color from Manufacturer's Standards.
2. Size: 36 in square
3. Wear layer thickness: 0.020 in.
4. Thickness: 1 in.

2.3 SPECIFICATIONS

A. Durometer Hardness: Shore, type A, durometer: 46-55 (ASTM D2240).

B. Flexibility: 300% modulus: 400 +/- 200 psi (ASTM D412).

C. Tensile Strength: 500-1000 psi (ASTM D412).

D. Slip Resistance (ASTM C1028-96)

1. Unfinished Tile Surface: Dry > 1.0, Wet > 1.0

E. Fire Rating (ASTM E648) and NFPA Flammability Rating

1. Unfinished Cushioned Flooring Tile Surface:

- a. ASTM E648 – Class 3

F. Surface options

1. Unfinished -- as-molded EPDM or SBR rubber surface. Solid color options. Surface has a 'tiled' appearance.

2.4 ACCESSORIES

A. Tapes & Adhesives

1. SmartCells tile edge glue instant adhesive: CA PLUS FS 500 CPS.
2. Double-sided tape for attaching ramp and transitions to the floor: POLYKEN 108.
3. Adhesive for Carpet Tile: Full spread acrylic-based, pressure-sensitive adhesive as recommended by carpet tile manufacturer.

B. Caulking/Sealants

1. Sealant for sealing unfinished SmartCells, coated SmartCells and Vinyl Covering top surfaces to walls and vertical surfaces: Clear Big Stretch D10240 mfg by Sashco for general water-resistant applications or E6100 Adhesive, non-sag formula, mfg by Eclectic Products for water proof applications.
- C. Transitions/Reducers
1. Exposed Transitions: 3.5" wide SmartCells Rubber Ramp: transitions from 1" to 1/8", can be used as a "snap-on" ramp to SmartCells tiles. For use with coated or unfinished SmartCells tiles. Color option: selected by Owner/Architect.
- D. Connectors
1. SmartCells connectors may be used to connect SmartCells tiles together without edge gluing. When SmartCells connectors are used the cushioning system will not result in a sealed surface.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to flooring manufacturer's written instructions to ensure adhesion of products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
 3. Alkalinity and Adhesion Testing: Perform tests recommended by flooring 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 9 pH.
 4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
1. At least 48 hours in advance of installation, move flooring tile and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by flooring tile.

3.2 EXAMINATION

- A. Substrate surface should be clean, water-tight, and smooth without abrupt changes in elevation. Chips or dents in the substrate surface greater than ½" in diameter may telegraph through to the surface. The Cushioned Floor surface will reflect general substrate unevenness. Provisions for leveling the substrate surface may be necessary but is not as critical as it is for the glue down of thin sheet flooring or floor tiles.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for installing flooring.

END OF SECTION 09 62 00

SECTION 09 65 19 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Vinyl composition floor tile.
 - 2. Wall Base.

1.2 ACTION SUBMITTALS

- A. Submit shop drawings, seaming plan, coving details, and manufacturer's technical data, installation and maintenance instructions (latest edition of Armstrong Flooring Guaranteed Installation Systems manual, F-5061. for flooring and accessories.
- B. Samples: For each exposed product and for each color and pattern specified with applicable accessories.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Include methods for maintaining installed products, and precautions against cleaning materials and methods detrimental to finishes and performance.
- B. Warranty: Warranty documents specified herein.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
 - 2. ASTM E 662 (NFPA 258) (Smoke Generation) Maximum Specific Optical Density of 450 or less.

2.2 VINYL COMPOSITION FLOOR TILE

- A. Products: Subject to compliance with requirements, provide one of the following:

1. AB; American Biltrite
2. Armstrong World Industries, Inc
3. Congoleum Corporation.
4. Or Approved equal

B. Tile Standard: ASTM F 1066, Class 2 through-pattern

C. Wearing Surface: Smooth

D. Thickness: 0.125 inch

E. Size: 12 by 12 inches

F. Color and Patters: As selected by Architect from full range of industry colors and patterns.

2.3 WALL BASE

1. For top wall base: Provide 4-inch high vinyl wall base with a matte finish, conforming to ASTM F 1861, Type TV – Vinyl Thermoplastic, Group 1 – Solid, Style B – Cove.

2.4 INSTALLATION MATERIALS

- A. Trowelable 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 type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
 1. Adhesives shall comply with the following limits for VOC content:
 - a. Vinyl Composition Tile Adhesives: 50 g/L or less.
 - b.
- C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

2.5 ACCESSORIES

- A. For sealing joints between the top of wall base or integral cove cap and irregular wall surfaces such as masonry, provide plastic filler applied according to the manufacturer's recommendations.
- B. Provide transition/reducing strips tapered to meet abutting materials.
- C. Provide threshold of thickness and width as shown on the drawings.
- D. Provide resilient edge strips of width shown on the drawings, of equal gauge to the flooring, homogeneous vinyl or rubber composition, tapered or bullnose edge, with color to match or contrast with the flooring, or as selected by the Architect from standard colors available.

- E. Provide metal edge strips of width shown on the drawings and of required thickness to protect exposed edges of the flooring. Provide units of maximum available length to minimize the number of joints. Use butt-type metal edge strips for concealed anchorage or overlap-type metal edge strips for exposed anchorage. Unless otherwise shown, provide strips made of extruded aluminum with a mill finish.

PART 3 - EXECUTION

3.1 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.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
 - 3. 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 9 pH.
 - 4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- C. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.
- D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- E. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- F. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.2 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles square with room axis, unless otherwise indicated in Plans.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
1. Lay tiles with grain running in one direction, unless otherwise indicated in Plans.
- 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 installation 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 substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- I. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.
1. Apply three coats.

END OF SECTION 09 65 19

SECTION 09 67 23 - RESINOUS FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes resinous flooring systems.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.
- B. Samples: For each resinous flooring system required, 6 inches (150 mm) square, applied to a rigid backing by Installer for this Project.
- C. Product Schedule: Use resinous flooring designations indicated in Part 2 and room designations indicated on Drawings in product schedule.
- D. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- E. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.3 INFORMATIONAL SUBMITTALS

- A. Material certificates.
- B. Material test reports.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

- C. Close spaces to traffic during resinous flooring application and for 24 hours after application unless manufacturer recommends a longer period.

PART 2 - PRODUCTS

2.1 PERORMANCE REQUIREMENTS

- A. Flammability: Self-extinguishing according to ASTM D 635.

2.2 RESINOUS FLOORING

- A. Resinous Flooring System: Abrasion-, impact-, and chemical-resistant, aggregate-filled, and resin-based monolithic floor surfacing designed to produce a seamless floor.
 - 1. Basis of Design: Stonhard, Inc.; Stongard TM
 - 2. Or approved equal.
- B. System Characteristics:
 - 1. Color and Pattern: A/E to select from Manufacturer's Standards
 - 2. Wearing Surface: Light or medium textured for slip resistance.
 - 3. Overall System Thickness: 1/8 inch .
- C. Primer: Type recommended by resinous flooring manufacturer for substrate and resinous flooring system indicated.
- D. Reinforcing Membrane: Flexible resin formulation that is recommended by resinous flooring manufacturer.
 - a. Provide fiberglass scrim embedded in reinforcing membrane.
 - b. Provide Hand laid 10 oz woven mat.
- E. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.
- F. Primer Coat:
 - 1. Resin: (2) two component epoxy.
 - 2. Formulation Description: 100 percent solids.
 - 3. Application Method: squeegee back roll.
 - 4. Number of Coats: .Two
 - 5. Thickness of Coats: 3/16 inch
- G. Body Coats:
 - 1. Resin: Urethane Membrane
 - 2. Formulation Description: 100 percent solids elastomeric
 - 3. Type: Pigmented.
 - 4. Application Method: Notched troweled.
 - 5. Number of Coats: One.
 - 6. Thickness of Coats: 3/16 inch
 - 7. Aggregates: Manufacturer's standard.

- H. Topcoats: Sealing or finish coats.
 - 1. Resin: Epoxy.
 - 2. Formulation Description: 100 percent solids, epoxy
 - 3. Type: Pigmented.
 - 4. Number of Coats: One.
 - 5. Thickness of Coats: 1/8 inch .
 - 6. Finish: Standard.
- I. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:
 - 1. Tensile Strength: 2,300 psi minimum according to ASTM D 638.
 - 2. Hardness: 80, Shore D per ASTM D 2240

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
 - 1. Roughen concrete substrates as follows:
 - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 - b. Comply with ASTM C 811 requirements unless manufacturer's written instructions are more stringent.
 - 2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
 - 3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
 - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. of slab area in 24 hours.
 - b. Plastic Sheet Test: ASTM D 4263. Proceed with application only after testing indicates absence of moisture in substrates.
 - c. Relative Humidity Test: Use in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 - 4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- C. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

- D. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

3.2 APPLICATION

- A. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
 - 1. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
- B. Primer: Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Reinforcing Membrane: Apply reinforcing membrane to entire substrate surface.
- D. Troweled or Screeded Body Coats: Apply troweled or screeded body coats in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When body coats are cured, remove trowel marks and roughness using method recommended by manufacturer.
- E. Grout Coat: Apply grout coat, of type recommended by resinous flooring manufacturer, to fill voids in surface of final body coat.
- F. Topcoats: Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer and to produce wearing surface indicated.
- G. Protect resinous flooring from damage and wear during the remainder of construction period.

END OF SECTION 09 67 23

SECTION 09 68 13 - TILE CARPETING

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes:
 - 1. Tile carpeting and accessories.
- B. Related Sections include the following:
 - 1. Division 3 Section "Cast-in-Place" for concrete work.
 - 3. Division 9 Section "Tile Carpeting" for carpet tile.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate required.
- B. 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.
 - 1. Tile Carpet: 12 inch square sample.
 - 2. Exposed Edge Stripping and Accessory: 12 inch long samples.
- C. Product Schedule: Use same room and product designations indicated on Drawings and in schedules.
- D. Maintenance Data: For tile carpet to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining tile carpet, including cleaning and stain removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet.

1.03 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced Installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.
- B. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with CRI 104, Section 5 "Storage and Handling."

1.05 PROJECT CONDITIONS

- A. General: Comply with CRI 104, Section 6.1 "Site Conditions; Temperature and Humidity."
- B. Environmental Limitations: Do not install tile carpet until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for its intended use.
- C. Do not install tile carpet over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by tile carpet manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of tile carpet, install tile carpet prior to installing these items.

1.06 WARRANTY

- A. Special Tile Carpet Warranty: Written warranty, signed by tile carpet manufacturer agreeing to replace tile carpet that does not meet comply with requirements or that fails within specified warranty period. Warranty does not include deterioration or failure of tile carpet due to unusual traffic, failure of substrate, vandalism, or abuse. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, and delaminations.

- 1. Warranty Period: 10 years from date of Substantial Completion.

1.07 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- 1. Tile Carpet: 5% of total install product.

PART 2 - PRODUCTS

2.01 TILE CARPET

- A. Basis of Design:

- 1. To be selected by Architect/Engineer and/or Owner.

2.02 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided by or recommended carpet manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed tile carpet and that is recommended by tile carpet manufacturer.
- C. 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.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting tile carpet performance. Verify that substrates and conditions are satisfactory for tile carpet installation and comply with requirements specified.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by the tile carpet manufacturer.
 - 2. Subfloor finishes comply with requirements specified in Section 03 30 00 – CAST-IN-PLACE CONCRETE for new slabs receiving tile carpet.
 - 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. General: Comply with CRI 104, Section 6.2 “Site Conditions; Floor Preparation,” and tile carpet manufacturer’s written installation instructions for preparing substrates indicated to receive carpet installation.
- B. Use trowelable leveling and patching compounds, according to manufacturer’s written instructions, to fill cracks, holes, and depression 1/8 wide or wider and protrusion more than 1/32 inch unless more stringent requirements are required by manufacturer’s written instructions for substrates.
- C. 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 tile carpet manufacturer.
- D. Broom and vacuum clean substrates to be covered immediately before installing tile carpet. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 INSTALLATION

- A. Direct Glue-Down Installation: Comply with CRI 104, Section 14 “Carpet Modules” and with carpet tile manufacturer’s written installation instructions.
- B. Comply with tile carpet manufacturer's written recommendations for direction of tile carpet; maintain uniformity of tile carpet direction and lay of pile.
- C. Cut and fit tile carpet 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 tile carpet manufacturer.
- D. Extend tile carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

- E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- F. Install pattern parallel to walls and borders.

3.04 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing tile carpet:
 - 1. Remove excess adhesive and other surface blemishes using cleaner recommended by tile carpet manufacturer.
 - 2. Remove yarns that protrude from tile carpet surface.
 - 3. Vacuum tile carpet using commercial machine with face-beater element.
- B. Protect installed tile carpet to comply with CRI 104, Section 16 "Protection of Indoor Installations."
- C. Protect tile carpet 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 tile carpet manufacturer.

END OF SECTION 09 68 13

SECTION 09 91 00 - PAINTING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This Section includes:
 - 1. Surface preparation and application of painting and related work in locations indicated on the Drawings and specified herein.
- B. Related Sections include the following:
 - 1. Division 5 Section "Metal Fabrications" for coating of fabricated metal items.
 - 2. Division 8 Section "Steel Doors and Frames" for coating steel doors and steel frames.
 - 3. Division 9 Section "Gypsum Wallboard" for painting gypsum board walls and ceilings.
 - 4. Division 9 Section "Portland Cement Stucco" for painting stucco finish system.

1.02 QUALITY ASSURANCE

- A. All surfaces of fabricated items that are left unfinished by the requirements of other sections shall be painted under this Section. All work specified in this Section shall be in addition to shop and mill coats, priming and field coats which are specified in other sections.
- B. Perform all touching up of shop coats and field coats of paint on structural steel and miscellaneous steel or iron as required and/or specified.
- C. Aluminum, steel, stainless steel, copper, bronze, chromium plating, nickel, monel metal, lead, lead coated copper and other surfaces with factory finishes shall not be painted or finished, except as otherwise specified.
- D. Remove and re-finish or otherwise correct in a manner approved by Architect/Engineer all work under this Section which peels, crazes, blisters, fails to adhere or otherwise fails to properly serve its intended purpose at no additional cost to the Owner.

1.03 PRODUCT DELIVERY AND STORAGE

- A. All materials shall be delivered to the Site in manufacturers' sealed packages, with labels intact.
- B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.04 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at

temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1.05 SUBMITTALS

- A. Product Data: Submit manufacturer=s product data for each type of product used.
- B. Samples: Submit three (3) sets of full color chip line for each type of paint specified, for color selection(s) by the Architect/Engineer.
- C. Draw Downs: Provide three (3) stepped draw downs, defining each separate coat, including block fillers and primers, for each color and material to be applied. Use representative colors when preparing draw down for review.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Conform to the coating specifications and standards referenced herein under PART 3.09 – PAINTING SCHEDULE.
- B. MPI System numbering system herein specified is found in either the MPI Architectural Painting Specification Manual or the Maintenance Repainting Manual and defined as an EXTERIOR or INTERIOR system.
- C. All ready-mixed paints shall be first-line (best quality grade) retail products. The use of lead-containing paint is NOT permitted.
- D. Thinners and additives shall be of types recommended by the paint manufacturer.
- E. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- F. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine the areas and conditions under which painting is to be applied. Do not proceed with painting work until unsatisfactory conditions have been corrected.

3.02 COLORS

- A. The Architect/Engineer will select all colors and provide a schedule of colors and finishes.
- B. Each coat of paint shall be applied in varying shades, with the final coat matching the approved color selected.

3.03 PREPARATION FOR PAINTING

- A. Surfaces to be painted shall be clean, smooth, free from scratches and dust and thoroughly dry.

Wood surfaces shall be well sanded before painting work is started.

- B. Concrete surfaces shall be cleaned, grouted, rubbed and pointed, water flushed clean and free of all dust, oily grease and laitance, and allowed to dry prior to painting.
- C. Steel and iron shall be free from grease, rust, scale and dust. Touch up any chipped or abraded places on items that have been shop coated. Where steel and iron have heavy coating of scale, it shall be removed by wire brush or sand blasting necessary to produce a satisfactory surface for painting.

3.04 PROTECTION

- A. Adjacent fixtures and hardware shall be removed during the painting application.
- B. Particular care shall be taken by the use of clean drop cloths, masking and other suitable means, to protect adjoining surfaces, fixtures, and materials of all kinds. Painting applicator shall be held responsible for, and shall repair, all damages resulting from the painting operation.
- C. All ceiling and soffit overhead painting shall be applied only while the floor is completely and continuously covered with drop cloths.

3.05 APPLICATION

- A. Paints shall be applied in the colors and minimum number of coats scheduled herein and at the square foot coverage as stated in the paint manufacturer's printed specifications. It is intended that paint so applied shall cover to the satisfaction of the Architect/Engineer or additional coats shall be applied until approval is obtained.
- B. Paints shall not be applied to surfaces which show a moisture content greater than 15 percent as determined by an electronic moisture meter.
- C. Paints shall not be applied when the temperature falls below 45 degrees F., in damp, rainy weather, or when the relative humidity exceeds 85 percent.
- D. Paint shall be evenly spread and well distributed. The finish coats shall be free from any noticeable laps, brush marks, streaks, runs, sags, wrinkles, and shiners.
- E. All wood surfaces shall be thoroughly sanded between coats as required for a flaw-free finish.

3.06 BACK PRIMING

- A. All wood surfaces (except pressure treated wood) to be placed against concrete or masonry substrates shall be painted with a sealer coat of paint or clear varnish before installation

3.07 TOUCH UP AND CLEANING

- A. Upon completion, all touching-up as required shall be applied and any paint shall be removed from all surfaces which are not specified to receive paint.

3.08 PAINTING OF PIPING FOR IDENTIFICATION

- A. Exposed piping, piping concealed in accessible pipe spaces and piping behind access panels shall be identified to designate service.
- B. Legend shall be stencil applied (painted on) at 40 feet spacing on straight runs where pipes pass through walls or floors and regulators, strainers, and clean-outs (except valves and fittings on

plumbing fixtures and equipment).

- C. Legend shall give name in full or abbreviations. Size of stenciled identity lettering shall vary with the diameter of pipe covering as follows:

1. Up to 1": 1/2" high letters.
2. Over 1": 3/4" high letters.

3.09 PAINTING SCHEDULE

- A. The following surfaces shall be finished with the designated number of coats (in addition to shop or manufacturer's coats) with a Dry Film Thickness (DFT) of not less than indicated:
- B. Omit primer on items with shop coat primer. All shop coats shall be touched up with the same kind of paint as the shop coat and allowed to dry before application of finish coats.

EXTERIOR

1. Metal, Galvanized: MPI EXT 5.3J-G5 – Waterborne Light Industrial - Semi-Gloss Finish.
 - a. Primer: MPI 134
 - b. Intermediate: MPI 163
 - c. Topcoat: MPI 163
 - d. System DFT: 4.5 mils.
2. Metal, Ferrous: MPI EXT 5.1Q-G5 – Alkyd - Semi-Gloss Finish.
 - a. Primer: MPI 23
 - b. Intermediate: MPI 94
 - c. Topcoat: MPI 94
 - d. System DFT: 5.25 mils.
3. Concrete: MPI EXT 3.1A – Latex - Semi-Gloss Finish.
 - a. Primer: MPI 10
 - b. Intermediate: MPI 10
 - c. Topcoat: MPI 10
 - d. System DFT: 3.5 mils.
4. Portland Cement Plaster (Stucco): MPI EXT 9.1A – Latex – Flat Finish.
 - a. Primer: MPI 10
 - b. Intermediate: MPI 10
 - c. Topcoat: MPI 10
 - d. System DFT: 3.5 mils.

INTERIOR

1. Metal, Galvanized: MPI INT 5.3J-G5 – Waterborne Latex - Semi-Gloss Finish.
 - a. Primer: MPI 134
 - b. Intermediate: MPI 43
 - c. Topcoat: MPI 43
 - d. System DFT: 4.5 mils.

2. Metal, Ferrous: MPI INT 5.1E-G5 – Alkyd - Semi-Gloss Finish.
 - a. Primer: MPI 79
 - b. Intermediate: MPI 47
 - c. Topcoat: MPI 47
 - d. System DFT: 5.25 mils.

3. Piping and Conduit, Exposed Surfaces: Semi-Gloss Finish.
 - a. Ferrous Metal: MPI INT 5.4F-G3 – Alkyd.
 - (1) Primer: MPI 79
 - (2) Intermediate: MPI 47
 - (3) Topcoat: MPI 47
 - (4) System DFT 4.4 mils

 - b. Aluminum and Galvanized Metal: MPI INT 5.4F-G3 - High Performance Architectural Latex.
 - (1) Primer: MPI 95
 - (2) Intermediate: MPI 139
 - (3) Topcoat: MPI 139
 - (4) System DFT: 5 mils

INTERIOR

4. Gypsum Drywall: MPI INT 9.2A-G3 – Latex - Eggshell Finish
 - a. Primer: MPI 50
 - b. Intermediate: MPI 52
 - c. Topcoat: MPI 52
 - d. System DFT: 4 mils

5. Masonry and Concrete: MPI INT 4.2D-G3 - High Performance Architectural Latex - Eggshell Finish
 - a. Filler: MPI 4
 - b. Primer: N/A
 - c. Intermediate: MPI 139
 - d. Topcoat: MPI 139
 - e. System DFT: 11 mils

6. Piping and Conduit, Exposed Surfaces: Semi-Gloss Finish.
 - a. Ferrous Metal: MPI INT 5.4F-G3 – Alkyd.
 - (1) Primer: MPI 79
 - (2) Intermediate: MPI 47
 - (3) Topcoat: MPI 47
 - (4) System DFT 4.4 mils

 - b. Aluminum and Galvanized Metal: MPI INT 5.4F-G3 - High Performance Architectural Latex.

(1)	Primer:	MPI 95
(2)	Intermediate:	MPI 139
(3)	Topcoat:	MPI 139
(4)	System DFT:	5 mils

END OF SECTION 09 91 00

DIVISION 10

SECTION 10 28 13 - TOILET ROOM ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes:
 - 1. Toilet accessories as indicated on the Drawings and herein specified.
 - 2. Refer to Drawings for listing of accessories.
- B. Related Sections include the following:
 - 1. Division 5 Section "Cold-Formed Metal Framing" for metal stud framing.
 - 2. Division 9 Section "Gypsum Wallboard" for wallboard sheathing.

1.02 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Products used in the work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production acceptable to the Architect/Engineer.
- B. Codes and Regulations: Comply with requirements of the Florida Building Code.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's technical information, catalog cuts, and installation instructions for each product to be furnished and installed.
- B. Warranty: Submit manufacturer's standard 10 year warranty for mirror glass against silver spoilage.

1.04 PRODUCT DELIVERY AND STORAGE

- A. Materials shall be delivered to Site undamaged. Materials shall be stored on the site in an area and in a manner to provide protection from damage until incorporated in the Work.

1.05 JOB CONDITIONS

- A. Inserts and Anchorages: Furnish inserts and anchoring devices which must be set in metal framed or masonry walls; coordinate delivery with other work to avoid delay.
- B. Accessory Locations:
 - 1. Coordinate accessory locations with other work to avoid interference and to assure proper operation and servicing of accessory units.
 - 2. Locations shall comply with State and Federal handicapped accessibility requirements for handicapped accessible units.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Products: Model numbers shown for accessories are units manufactured by Bobrick Washroom Equipment Company, Inc., unless otherwise specified. Provide products by Bobrick or by one of the following manufacturers:
 - 1. A&J Washroom Accessories.
 - 2. American Specialties Inc.
 - 3. Bradley Corp.

2.02 MATERIALS, GENERAL

- A. Stainless Steel: ASTM A 666 Type 304, with polished No. 4 finish, 22 gauge minimum, unless otherwise indicated.
- B. Mirror Glass: ASTM C 0148, Type I, Class 1, Quality q2, 1/4 inch thick, with silvering, copper coating, and protective organic coating complying with FS DD-M-411. Polished edge, fully protected with padding.
- C. Galvanized Steel Mounting Devices: ASTM A 153, hot-dip galvanized after fabrication.
- D. Fasteners: Screws, bolts, and other devices of same material as accessory unit or of galvanized steel where concealed, theft and vandal resistant.

2.03 FABRICATION

- A. General: Stamped names or labels on exposed faces of toilet accessory units are NOT permitted. Where locks are required for a particular type of toilet accessory, provide same keying throughout Project. Furnish two (2) keys for each lock.
- B. Recessed Toilet Accessories: Except where otherwise indicated, fabricate units of all welded construction, without mitered corners. Hang doors or access panels with continuous stainless steel piano hinges. Provide anchorage which is fully concealed when unit is closed.

2.03 FABRICATION

- A. Under lavatory Guard:
 - 1. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
 - 2. Material and Finish: Antimicrobial, molded plastic, white.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install toilet accessories in accordance with manufacturer's instructions, using fasteners which are appropriate to substrate and recommended by manufacturer of unit. Install units plumb and level, firmly anchored in locations and at heights indicated.

3.02 ADJUSTING AND CLEANING

- A. Adjust toilet accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.
- B. Clean and polish all exposed surfaces after removing temporary labels and protective coatings.

3.03 TOILET ACCESSORY SCHEDULE

- A. Refer to Drawings for the toilet accessory schedule.

END OF SECTION 10 28 13

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DIVISION 21

SECTION 21 05 00 – COMMON WORK RESULTS FOR FIRE SUPPRESSION

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. Piping materials and installation instructions common to most piping systems.
 - 2. Mechanical sleeve seals.
 - 3. Sleeves.
 - 4. Escutcheons.
 - 5. Grout.
 - 6. Fire-suppression equipment and piping demolition.
 - 7. Equipment installation requirements common to equipment sections.
 - 8. Painting and finishing.
 - 9. Concrete bases.
 - 10. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, 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 chases.
- 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. (No CPVC or PVC to be utilized for sprinkler piping. PVC only to be used for drain relief of equipment).
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.

2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For the following:
 1. Mechanical sleeve seals.
 2. Escutcheons.
- B. Welding certificates.

1.5 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 Fire-Suppression 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.

1.6 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.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression 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 fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 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 21 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 21 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. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- G. Solvent Cements for Joining CPVC Plastic Piping: ASTM F 493. No CPVC or PVC to be utilized for sprinkler piping. PVC only to be used for drain relief of equipment.

2.4 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: Carbon steel or Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

- A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- B. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. 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.
- D. PVC Pipe: ASTM D 1785, Schedule 40. (No CPVC or PVC to be utilized for sprinkler piping. PVC only to be used for drain relief of equipment).
- E. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 PIPING 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, Cast-Brass Type: With set screw.
 1. Finish: Polished chrome-plated.
- C. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 1. Finish: Polished chrome-plated.
- D. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.
- E. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw, and chrome-plated finish.

2.7 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 21 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. Bare Piping at Wall Ceiling and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
- M. Permanent sleeves are not required for holes formed by removable PE sleeves.
- N. 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. PVC or Steel Pipe Sleeves.
 - b. 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 07 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 07 Section "Joint Sealants" for materials and installation.
- O. 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.
- P. 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.
- Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- R. Verify final equipment locations for roughing-in.
- S. 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 21 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. 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.
- F. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- H. Plastic Piping Solvent-Cement Joints (No CPVC or PVC to be utilized for sprinkler piping. PVC only to be used for drain relief of equipment): 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 (No CPVC or PVC to be utilized for sprinkler piping. PVC only to be used for drain relief of equipment): Join according to ASTM D 2846/D 2846M Appendix.

3.3 PAINTING

- A. Painting of fire-suppression systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- C. All exposed sprinkler, pipe and standpipe shall be painted in red.
- D. Provide concealed plates at the wood ceiling with: SW 9100 – Umber Rust. Refer to general notes on construction documents for additional coordination notes.

3.4 CONCRETE BASES

- A. Concrete Bases: Shall be coordinated with Division 03

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.6 GROUTING

- A. Mix and install grout for fire-suppression 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 21 05 00

SECTION 21 05 17 – SLEEVES AND SLEEVE DEALS FOR FIRE-SUPPRESSION 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 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Stack-sleeve fittings.
 - 3. Sleeve-seal systems.
 - 4. Sleeve-seal fittings.
 - 5. Grout.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- D. Molded-PE Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Smith, Jay R. Mfg. Co.
 - 2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
- B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.

- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 2. Pressure Plates: Carbon steel.
 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Presealed Systems.
- B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 2. 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.
 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
1. Cut sleeves to length for mounting flush with both surfaces.

2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 5. Using grout, seal the space around outside of stack-sleeve fittings.
- B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
1. Exterior Concrete Walls above Grade:
 - a. Piping Smaller Than NPS 6 Galvanized-steel-pipe sleeves with sleeve seal system.
 - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.
 2. Exterior Concrete Walls below Grade:

- a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
- 3. Concrete Slabs-on-Grade:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
- 4. Concrete Slabs above Grade:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves, PVC-pipe sleeves, Stack-sleeve fittings, Sleeve-seal fittings, Molded-PE or Molded-PVC sleeves.
 - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.
- 5. Interior Partitions:
 - a. Piping Smaller Than NPS 6 Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 21 05 17

SECTION 21 05 18 – ESCUTCHEONS FOR FIRE-SUPPRESSION 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 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.
- C. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. New Piping: One-piece, floor-plate type.
 - 2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 21 05 18

SECTION 21 05 53 – IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

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. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Stencils.
 - 5. Valve tags.
 - 6. Warning tags.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.
- D. Valve Schedules: Valve numbering scheme.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: anodized aluminum, 0.032 inch (0.8 mm) thick, with predrilled holes for attachment hardware.
 - 2. Letter Color: White.
 - 3. Background Color: Red.
 - 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
 - 5. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 6. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- C. Equipment-Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, with predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Red.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; pipe size; and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.
- E. Pipe-Label Colors:
 - 1. Background Color: Red.
 - 2. Letter Color: White.

2.4 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
 - 1. Stencil Material: Fiberboard or metal
 - 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.

2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping-system abbreviation and 1/2-inch (13-mm) numbers.
 - 1. Tag Material: Brass, 0.032 inch (0.8 mm) thick, with predrilled holes for attachment hardware.
 - 2. Fasteners: Brass wire-link chain.
 - 3. Valve-Tag Color: Red.
 - 4. Letter Color: White.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: Approximately 4 by 7 inches (100 by 178 mm).
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 LABEL INSTALLATION

- 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 locations of access panels and doors.
- C. Install or permanently fasten labels on each major item of mechanical equipment.
- D. Locate equipment labels where accessible and visible.
- E. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."

- F. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Near each valve and control device.
 2. Near each branch connection excluding short takeoffs. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and inaccessible 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 (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

3.3 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems. List tagged valves in a valve-tag schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:
1. Valve-Tag Size and Shape:
 - a. Fire-Suppression Standpipe: 2 inches (50 mm), round.
 - b. Wet-Pipe Sprinkler System: 2 inches (50 mm), round.
 - c. Foam-Water System: 2 inches (50 mm), round.

3.4 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 21 05 53

SECTION 21 13 13 – WET-PIPE SPRINKLER SYSTEM

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. Pipes, fittings, and specialties.
 - 2. Fire-protection valves.
 - 3. Sprinklers.
- B. Related Sections:
 - 1. Division 21 Section "Fire-Suppression Standpipes" for standpipe piping.
 - 2. Division 21 Section "Dry-Pipe Sprinkler Systems" for dry-pipe sprinkler piping.
 - 3. Division 21 Section for fire pumps, pressure-maintenance pumps, and fire-pump controllers.

1.3 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

1.4 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.5 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- B. Sprinkler system shall be approved by authorities having jurisdiction.
 - 1. Margin of Safety for Available Water Flow and Pressure: 10 P.S.I.
 - 2. Sprinkler Occupancy Hazard Classifications refer to drawings.

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

- B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
- C. Hydraulic Calculations.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include fabricating, and installing sprinkler systems and providing working plans per NFPA 13. Base calculations on results of fire-hydrant flow test.
- B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. 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.
- D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
 - 1. NFPA 13, "Installation of Sprinkler Systems."
 - 2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

1.8 PROJECT CONDITIONS

- A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
 - 1. Notify Architect and Construction Manager no fewer than two days in advance of proposed interruption of sprinkler service.
 - 2. Do not proceed with interruption of sprinkler service without Architect's and Construction Manager's written permission.

1.9 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

PART 2 - PRODUCTS

2.1 STEEL PIPE AND FITTINGS

- A. Standard Weight, Black-Steel Pipe: ASTM A 53/A 53M or ASTM A 135.
- B. Piping Schedule shall be: All piping with threaded fittings shall be schedule 40 and all piping with grooved fittings shall be schedule 10.

- C. Galvanized- and Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- D. Galvanized and Uncoated, Steel Couplings: ASTM A 865, threaded.
- E. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- F. Grooved-Joint, Steel-Pipe Appurtenances:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Tyco Fire & Building Products LP.
 - b. Victaulic Company.
 - c. Anvil Star Piping Inc.
 - 2. Pressure Rating: 175 psig unless otherwise noted.
 - 3. Galvanized and Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
 - 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.2 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.
 - 1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
 - 2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- E. Solvent Cements for Joining plastic Piping and Tubing (No CPVC or PVC to be utilized for sprinkler piping. PVC only to be used for drain relief of equipment): ASTM F 493, solvent cement recommended by pipe and fitting manufacturer, and made for joining CPVC pipe and fittings. Include cleaner or primer recommended by pipe and fitting manufacturer.
 - 1. Use solvent cement that has a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Use adhesive primer that has a VOC content of 650 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Plastic, Pipe-Flange Gasket, and Bolts and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.3 LISTED FIRE-PROTECTION VALVES

A. General Requirements:

1. Valves shall be UL listed or FM approved.
2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.
3. Minimum Pressure Rating for High-Pressure Piping: 300 psig.

B. Ball Valves:

1. Standard: UL 1091 except with ball instead of disc.
2. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
3. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
4. Valves NPS 3: Ductile-iron body with grooved ends.

C. Check Valves:

1. Standard: UL 312.
2. Pressure Rating: 300 psig.
3. Type: Swing check.
4. Body Material: Cast iron.
5. End Connections: Flanged or grooved.

D. Iron Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Kennedy Valve; a division of McWane, Inc.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Tyco Fire & Building Products LP.
 - f. Victaulic Company.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig.
4. Body Material: Cast or ductile iron.
5. Style: Lug or wafer.
6. End Connections: Grooved.

2.4 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

1. Reliable Automatic Sprinkler Co., Inc.
2. Tyco Fire & Building Products LP.
3. Viking Corporation.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Residential Sprinklers: 175 psig maximum.
3. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
4. Pressure Rating for High-Pressure Automatic Sprinklers: 300 psig.
5. Refer to drawings for sprinkler types and applicable locations.

2.5 GROUT

- A. Standard: ASTM C 1107, Grade B, posthardening and volume adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink, and recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

- A. Connect sprinkler piping to water-service piping for service entrance to building.
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.

3.3 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

- F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- G. Install sprinkler piping with drains for complete system drainage.
- H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- I. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- J. Install alarm devices in piping systems.
- K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13. Powder driven inserts are not allowed.
- L. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- M. Fill sprinkler system piping with water.

3.4 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. 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.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

- I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.
- K. Plastic-Piping, Solvent-Cement Joints (No CPVC or PVC to be utilized for sprinkler piping. PVC only to be used for drain relief of equipment): 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. Apply primer.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

3.5 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
 - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
 - 2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

3.6 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels or as indicated on drawings. In hard ceiling areas align or centered between lights or as indicated on drawings. Sprinklers may be centered in tile either by hard pipe or with flexible connectors. Connectors shall be UL 2443 listed, Flex Heads Industries or equal.
- B. Sprinkler Head Location: Sprinkler heads shall be installed no closer than 4 inches to any Ceiling grid or wall.
- C. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

3.7 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for Piping:

1. Piping with Fitting or Sleeve Protruding from Wall: deep pattern.
2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: cast brass with polished chrome-plated finish.
3. Bare Piping at Ceiling Penetrations in Finished Spaces cast brass with polished chrome-plated finish.

3.8 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."
- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.
- J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- K. Install sleeve materials according to the following applications:
 1. Sleeves for Piping Passing through Concrete Floor Slabs: Molded PVC.
 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Stack sleeve fittings.
 - a. Extend sleeves 2 inches above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements for flashing in Division 07 Section "Sheet Metal Flashing and Trim."
 3. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. PVC-pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.
 - c. Exception: Sleeves are not required for water-supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.

4. Sleeves for Piping Passing through Concrete Roof Slabs: Molded PVC.
5. Sleeves for Piping Passing through Exterior Concrete Walls:
 - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
 - b. Cast-iron wall pipe sleeves for pipes NPS 6 and larger.
 - c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
 - d. All exterior sleeves shall be sealed water tight.
6. Sleeves for Piping Passing through Interior Concrete Walls:
 - a. PVC-pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestop materials and installations in Division 07 Section "Penetration Firestopping."

3.9 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 4. Energize circuits to electrical equipment and devices.
 5. Start and run excess-pressure pumps.
 6. Coordinate with fire-alarm tests. Operate as required.
 7. Coordinate with fire-pump tests. Operate as required.
 8. Verify that equipment hose threads are same as local fire-department equipment.
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 21 13 13

DIVISION 22

SECTION 22 05 00 – BASIC PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Basic Requirements: Requirements of the Contract Forms, Conditions of the Contract, Specifications, Drawings, and Addenda and Contract Modifications (the Contract Documents), apply to the requirements of each Section of Division 22.
- B. Conflicts: Nothing contained in this Section shall be construed to conflict in any way with other provisions or requirements of the Contract documents. The intent is that this Section will take precedence. Where differences arise, the Architect shall decide which directions or instructions take precedence.

1.2 SUMMARY

- A. General: Unless an item is specifically mentioned as being provided by others, the requirements of Division 22 Contract Documents shall be completed. The 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 furnished, delivered and installed without additional expense to the Owner. 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 APPLICABLE STANDARDS

- A. Code Compliance: Refer to Division 1. As a minimum, unless otherwise indicated, comply with all rules, regulations, standards, codes, ordinances and laws of local, state and federal governments and the amendments and interpretation of such rules, regulations, standards, codes, ordinances and laws of local, state and federal governments by the authorities having lawful jurisdiction.
- B. ADA: Comply with the requirements of the Americans with Disabilities Act (ADA).
- C. Comply: With the National Fire Protection Association (NFPA) Standards and other Codes and Standards as adopted by the Local Authority having Jurisdiction.
- D. Florida Building Code 2017: Conform in strict compliance to the Florida Building Code (FBC), 2017 6th Edition.
 - 1. Florida Building Code – Plumbing 2017 Edition
 - 2. Florida Building Code – Fuel Gas 2017 Edition
 - 3. Florida Building Code – Chapter 13 Florida Energy Efficiency for Building Construction 2017 Edition
 - 4. Florida Building Code – Mechanical 2017 Edition
- E. NATIONAL FIRE PROTECTION (NFPA) Standards
 - 1. NFPA-13, Standard for the Installation of Sprinkler Systems, 2013 Edition
 - 2. NFPA-70, National Electrical Code, 2011 Edition
- F. Notification: Comply with all of the requirements of the Federal "Right-To-Know" Regulations and the Florida "Right-To-Know" Law and provide notification to all parties concerned as to the use of toxic substances.
- G. Florida DOE Requirements: Comply with the requirements of the Department of Education's design standard, State Requirements for Educational Facilities (SREF), 2007.

- H. Owner Design Guidelines: Comply with all the requirements of the latest Owner MEP Engineering Design Guidelines and the latest Owner Architectural Construction Standards.

1.4 DRAWINGS AND SPECIFICATIONS

- A. Intent: The intent of the drawings and specifications is to establish minimum acceptable quality standards for materials, equipment and workmanship, and to provide operable mechanical systems complete in every respect.
- B. Equipment Placement: The drawings are diagrammatic, intended to show general arrangement, capacity and location of various components, equipment and devices. Each location shall be determined by reference to the general building plans and by actual measurements in the building as built. Reasonable changes in locations ordered by the Architect prior to the performance of the affected Work shall be provided at no additional cost to the Owner.
- C. 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.
- D. Conflict: In the event of a conflict, the Architect will render an interpretation in accordance with the General Conditions.

1.5 DEFINITIONS

- A. Provide/Install: The word "provide" shall mean furnish, install, connect, test, complete, and leave ready for operation. The word "install" where used in conjunction with equipment furnished by the Owner or under another contract shall mean mount, connect, complete, and leave ready for operation.
- B. Concealed: The surface of insulated or non-insulated piping or equipment is concealed from view when standing inside a finished room, such as inside a chase or above a ceiling.
- C. Exposed: The surface of insulated or non-insulated piping or equipment is seen from inside a finished room, such as inside an equipment or air handling unit room.
- D. Protected: The surface of insulated or non-insulated piping or equipment on the exterior of the building but protected from direct exposure to rain by an overhang, eave, in an unconditioned parking garage or building crawl space.
- E. Unprotected: The surface of insulated or non-insulated piping or equipment on the exterior of the building and exposed to rain.
- F. Abbreviations: Abbreviations, where not defined in the Contract Documents, shall be interpreted to mean the normal construction industry terminology, as determined by the Architect. Plural words shall be interpreted as singular and singular words shall be interpreted as plural where applicable for context of the Contract Documents.

1.6 SUBMITTAL

- A. General: The provisions of this section are supplemental to the requirements in Division 1, and only apply to the material and equipment covered in Division 22.
- B. Time: Submit manufacturer's literature, performance data and installation instructions covered in each Section of Division 22 under an individual letter of transmittal within 30 days after Notice to Proceed unless otherwise indicated.

- C. Submitter's Review: All items required for each section shall be reviewed before submittal. Submittal information for each item shall bear a review stamp of approval, indicating the name of the Contractor and Subcontractor (where applicable), the material suppliers, the initials of submitter and date checked. Responsibility for errors or omissions in submittals shall not be relieved by the Architect's review of submittals. Responsibility for submittals cannot be subrogated to material suppliers by Contractors or Subcontractors.
1. Review of the submittal data, whether indicated with "APPROVED" or with review comments, does not constitute authorization for or acceptance of a change in the contract price.
- D. Architect's Review: The submittal data shall be reviewed only for general conformance with the design concept of the project and for general compliance with the Contract Documents. Any action indicated is subject to the requirements of the Contract Documents. Reviews of submittal data review shall not include quantities; dimensions (which shall be confirmed and correlated at the job site); fabrication processes; techniques of construction; and co-ordination of the submittal data with all other trades. Copies of the submittal data will be returned marked "ACCEPTED AS SUBMITTED", "ACCEPTED AS NOTED", "REVISED AS NOTED AND RESUBMIT", "REJECTED, REVISED AS NOTED AND RESUBMIT".
- E. Submittal Items: Submittal items shall be inserted in a Technical Information Brochure. Mark the appropriate specification section or drawing reference number in the right hand corner of each item. All typewritten pages shall be on the product or equipment manufacturer's printed letterhead.
1. Manufacturer's Literature: Where indicated, include the manufacturer's printed literature. Literature shall be clearly marked to indicate the item intended for use.
 2. Performance Data: Provide performance data, wiring and control diagrams and scale drawings which show that proposed equipment will fit into allotted space (indicate areas required for service access, connections, etc.), and other data required for the Architect to determine that the equipment complies with the Contract Documents. Where noted, performance data shall be certified by the manufacturer at the design rating points.
 3. Installation Instructions: Where requested, each product submittal shall include the manufacturer's installation instructions. Generic installation instructions are not acceptable. Instructions shall be the same as those included with the product when it is shipped from the factory.
 4. Written Operating Instructions: 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. Operating Instructions shall be submitted immediately after the product or equipment submittal has been returned from the Architect marked "APPROVED" or "APPROVED AS NOTED".
 5. Maintenance Instructions: Information 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. Submit maintenance instructions immediately after the product or equipment submittal has been returned from the Architect marked "APPROVED" or "APPROVED AS NOTED".
- F. Substitutions:
1. General: Refer to Division 1. Substitutions may be considered for any product or equipment of a manufacturer. See paragraph entitled "MANUFACTURER" in this Section. Any product or equipment may be submitted for review; however, only one substitution per item will be considered. If a substituted product or equipment item is rejected, provide the specified product or equipment.
 - a. Submittal shall include the name of the material or equipment to be substituted, equipment model numbers, drawings, catalog cuts, performance and test data and any other data or information necessary for the Architect to determine that the equipment meets the specification requirements. If the Architect accepts any proposed substitutions, such acceptance will be set forth in writing.
 - b. Substituted equipment with all accessories installed or optional equipment where permitted and found acceptable, must conform to space requirements. Substituted equipment that cannot meet space requirements, whether accepted or not, shall be replaced at no additional expense to the Owner. If the substituted item affects the work of other trades, the Request for Substitution form shall include a list of the necessary modifications.

2. Deviations: The Request for Substitution form shall include a complete list of deviations from the scheduled item stating both the features and functions of the scheduled item and the comparable features and functions of the proposed substitution.
 - a. Any deviation not indicated in writing will be assumed to be identical to the specified item even if it is shown otherwise on the submittal data.
 - b. If a deviation not listed is found anytime after review and acceptance by the Architect and that deviation, in the opinion of the Architect, renders the substituted item as unacceptable, the item shall be removed and replaced by the scheduled item at no additional cost to the Owner.
 - c. The Architect shall retain the right to specify modifications to the substituted item, correcting or adjusting for the deviation, if the Architect deems it to be in the best interest of the Owner.
 3. Scheduled Item: A scheduled item is a product or item of equipment indicated in the Contract Documents by manufacturer's name and model number identifying a single item. The manufacturer's trade name for a group of products that does not signify a single item including type, style, quality, performance, and sound rating shall not be classified as a scheduled item. Where more than one manufacturer and product model number are indicated, each shall be considered as a scheduled item.
 4. Form: When a product or item of equipment is proposed as a substitution a "REQUEST FOR SUBSTITUTION" form shall be completed and submitted with the required data. A copy of the form is included after the end of this section.
 5. Rejection: Substituted products or equipment will be rejected if, in the opinion of the Architect, the submittal does not meet any one of the following conditions or requirements:
 - a. The submittal data is insufficient or not clearly identified. The Architect may or may not request additional information.
 - b. The product or equipment will not fit the space available and still provide the manufacturers published service area requirements.
 - c. The product or equipment submitted is not equivalent to or better than the specified item. Products or equipment of lesser quality may be considered provided an equitable financial rebate, satisfactory to the Architect, is to be returned to the Owner.
 - d. The product or equipment submitted has less capacity, efficiency and safety provisions than the specified item.
 - e. The product or equipment submitted does not have warranty, service and factory representation equivalent to that specified.
 - f. The Owner prefers not to accept the submitted product.
- G. Technical Information Brochure:
1. Binder: Include binders with the first submittal for the Technical Information Brochure. Each binder shall be size 3 inch, hardcover, 3-ring type for 8-1/2" X 11" sheets. Provide correct designation on outside cover and on spine of each binder, i.e., MECHANICAL SUBMITTAL DATA, MECHANICAL OPERATION INSTRUCTION and MECHANICAL MAINTENANCE INSTRUCTIONS.
 2. Number: Submit not less than five sets of binders for each of the three mechanical brochures indicated above. Each set shall consist of a minimum of two binders for submittal data and 1 binder each for operating instructions and for maintenance instructions. Additional binders shall be submitted at the request of the Architect. One set of binders shall be retained by the Architect. Three sets of binders shall be maintained for the Owner and the remaining set shall become the property of the Engineer.
 3. Index: First sheet in each brochure shall be a photocopy of the "Division 22 Index" of the specifications. Second sheet shall list the firm name, address, phone number, superintendent's name for the contractor and all major subcontractors and suppliers associated with the project.
 4. Dividers: Provide reinforced separation sheets tabbed with the appropriate specifications Section reference number for each Section in which submittal data or operation and maintenance instructions is required.
 5. Specifications: Insert a copy of the specifications for each Section and all addenda applicable to the Section between each of the Section dividers.

1.7 MANUFACTURER'S CHECKOUT

- A. Start-up and Checkout: At completion of installation and prior to performance verification, a factory-trained representative of the manufacturer shall provide start-up and checkout service. After the performance verification the manufacturer's representative shall examine performance information and check the equipment in operation, and sign "Check-Out Memo" for the record. Submit a copy of Memo on each item of equipment where indicated in individual sections of these specifications for inclusion in each Technical Information Brochure. The "Check-Out Memo" shall be included with the performance verification data. Do not request "Instruction in Operation Conference" or request final inspection until Memos have been submitted and found acceptable.

1.8 INSTRUCTION TO OWNER

- A. General: Instructions to the Owner shall be by competent representatives of the manufacturers involved, with time allowed 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: Unless otherwise indicated training periods shall encompass the following number of hours of classroom and hands-on instructions with a maximum period of 4 hours per day for either. Mixing classroom instructions and hands on training in the same day is unacceptable.
 - 1. Training periods:
 - a. 4 hours Classroom
 - b. 4 hours Hands-on
- C. Scheduling: Submit any remaining required items for checking at least one week before final inspection of building. When submittal items are found acceptable, notify Owner, in writing, that an "Instruction in Operation Conference" may proceed. Conference will be scheduled by the Owner. After the conference, copies of a memo certifying that the "Instruction in Operation Conference" and "Completed Demonstration" have been made will be signed by Owner and the instructors, and one copy will be inserted in each Technical Information Brochure.

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. The listing of additional manufacturers in no way indicates that the manufacturer can provide an acceptable 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 shop drawing. When the manufacturer does not indicate the space required for servicing the equipment, the space shown on the drawings or as required by the Architect 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 Architect.
- B. Specified Equipment: Equipment shall be the capacity and types indicated or shall be equivalent in the opinion of the Architect. Material and equipment furnished and installed shall be new, recently manufactured, of standard first grade quality and designed for the specific purpose. 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: The installation of materials and equipment shall be done in a neat, workmanlike and timely manner by an adequate number of craftsmen knowledgeable of the requirements of the Contract Documents. They shall be skilled in the methods and craftsmanship needed to produce a first-quality installation. Personnel who install materials and equipment shall be qualified by training and experience to perform their assigned tasks. All materials and equipment shall be installed per the manufacturer's written requirements.
- B. Acceptable Workmanship: Acceptable workmanship is characterized by first-quality appearance and function which conforms to applicable standards of building system construction and exhibits a degree of quality and proficiency which is judged by the Architect as equivalent or better than that ordinarily produced by qualified industry tradesmen.
- C. Performance: Personnel shall not be used in the performance of the installation of material and equipment who, in the opinion of the Architect, are deemed to be careless or unqualified to perform the assigned tasks. Material and equipment installations not in compliance with the Contract Documents, or installed with substandard workmanship in the opinion of the Architect, shall be removed and reinstalled by qualified craftsmen at no change in the contract price.

3.2 CLEANING AND PROTECTION

- A. General: Refer to Division 1.
- B. Emergency Contacts: Prior to the beginning of the project, provide the Owner with a list of names, emergency telephone and beeper numbers of individuals who can be contacted during working and non-working hours, including weekends, for assistance throughout the warranty period if leaks, equipment failure or other damages occur. Update the list throughout installation and warranty to provide continuous availability of responsible parties to the Owner. If the Owner cannot contact the responsible party during an emergency situation, the Owner may effect emergency repairs through other means and may backcharge for the costs of repair material and labor incurred.
- C. Housekeeping: Keep interiors of pipe systems clean and free from dirt, rubbish and foreign matter. Close open ends of piping at all times throughout the installation. Prevent dust, debris and foreign material from entering the piping.

- D. 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.
- E. Equipment Cleaning: Thoroughly clean equipment and entire piping systems internally upon completion of installation and immediately prior to final acceptance. 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. (See para. 3.2 above.)
- F. Building Cleanup: Remove debris, rubbish, leftover materials, tools and equipment from work areas and site. Clean tunnels and closed off spaces of packing boxes, wood frame members and other waste materials used in the installation. Final acceptance shall not be approved until site is cleaned.
- G. Fixture Cleanup: Remove temporary labels, stickers, etc., from fixtures and equipment. Do not remove permanent nameplates, equipment model numbers, ratings, etc.
- H. 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 Architect the discrepancies will affect system balance and performance.

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 or repair of all electric or pneumatic 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 Architect. 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 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, in the opinion of the Architect, 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 Architect replace or repair to "as new" condition equipment which has been damaged during construction.
- D. During construction, all piping system openings shall be capped with at least two layers of polyethylene film, fastened tightly in place with banding material or foil tape until connection of the continuation of such piping is occurring.

3.6 ASBESTOS AND HAZARDOUS MATERIALS

- A. General: Should asbestos or other hazardous material be encountered during execution of the work, or should the presence of asbestos or other hazardous material be suspected, immediately notify the Architect and suspend work in the affected area. The Owner will initiate a study to determine if asbestos or other hazardous materials are present and will determine what action will be taken. Removal of asbestos or other hazardous materials will be done under a separate contract.

3.7 COORDINATION OF SERVICES

- A. General: Coordinate interruption of existing services in writing at least 1 week in advance with the Architect. Shutdown time and duration of services interruption shall be decided by the Owner. Provide shutoff valves at points of interconnection to minimize downtime. Procedures incidental to the outage shall be prepared in advance to minimize downtime.
- B. Fire Safety in Existing facilities: Do not decrease the fire rating of walls, partitions, ceilings, floors, doors or combinations thereof in adjacent areas or means of egress. Do not interrupt fire sprinkling or life safety systems without prior coordination with the Architect. Inform all necessary parties (Fire Department, Owner's insurance carrier, etc.) in advance, prior to and immediately after shutdown, disconnection or isolation of any portion of life safety or fire sprinkler system.
- C. Protection of Facilities: Portions of the building may be operational during construction. Maintain operation of the equipment and systems whenever the installation interfaces with existing equipment or systems. Provide protection for the building, its contents and occupants wherever installation under the contract is performed. As necessary, move, store, and protect furniture, office fixtures and carpets. Provide acoustical isolation of the work area with temporary doors, partitions, etc., to allow normal work functions. Provide exhaust fans, temporary dust barrier partitions and any containment measures required to prevent dirt, dust or fumes from reaching adjacent occupied spaces as required by the Owner or Architect. Access to the building, including exit stairs, doors and passageways, and loading dock and other delivery areas shall be kept open and continuously accessible to the occupants. Workmen shall be confined to those areas directly involved in the project installation, and only during time periods indicated and approved by the Owner.

3.8 LAYOUT OF EXISTING EQUIPMENT

- A. General: Existing equipment, piping, etc., as indicated on the drawings have, for the most part, been provided to the Architect through existing drawings. The layouts shown may not be from as-built drawings and may be from partial copies of original design documents not produced by the Architect. The Architect is not responsible for the accuracy nor completeness of the existing installation and all layouts are shown for reference only. It is to be understood that unforeseen conditions probably exist and that existing and new work may not be field located exactly as shown on the drawings. Verify existing conditions in the field and notify the Architect of any deviations required to install the work as shown. Coordinate new work with existing equipment, including removing, relocating, rerouting, extending with new materials, and reinstall existing piping, conduits, wiring, tubing, supports and other equipment. The Architect shall make the final decision on all deviations or modifications required by the existing conditions.

3.9 OWNERSHIP OF REMOVED EQUIPMENT

- A. General: Construction materials and items of mechanical and electrical equipment which are removed and not reused shall be removed from the job-site unless indicated as to be retained for the Owner. Include rigging, removal and hauling cost, as well as any salvage value, in the contract.

3.10 CLEAN-UP

- A. General: Debris and rubbish shall not be disposed into the Owner's containers.

END OF SECTION 22 05 00

REQUEST FOR SUBSTITUTION (Must be Submitted Prior to Bid)

Project Name: _____ Location: _____

Date of Request: _____

Name of Party Requesting Substitute:

Reason for Substitution Request:

<u>Drawing</u>	<u>Spec. Sect. No.</u>	<u>Paragraph</u>	<u>Specified Item Manu</u>	<u>Model</u>
_____	_____	_____	_____	_____

Proposed Substitute: _____

Manufacturer and Model Number:

Deviations from the Specified Item: (See paragraph entitled "Deviations".)

Reason for Substitution:

Changes to Other Systems to Permit Use of Proposed Substitute:
(List changes. Submit drawings if required for clarity.)

Technical Data to Support Request for Acceptance:
(List ASTM or other standards designations, testing laboratory reports, experience records, etc.)

Other Supporting Data:
(Submit brochures, samples, drawings, etc.)

Certification: In making request for substitution, the party whose authorized signature appears below, certifies that all of the following statements are correct and are accepted without exception:

The proposed substitution has been personally investigated and is equal or superior in all significant respects to the product specified for the specific applications required;

The proposed substitution will be warranted under the same terms required for the specified product;

Coordination aspects necessitated by the proposed substitution will be accomplished in a complete and proper fashion by the party signing this form without any additional cost to the Owner; and

Claims against the Owner for additional costs related to the proposed substitution which subsequently become apparent after acceptance by the Architect are hereby waived.

Credit: If this substitution is acceptable the following credit shall be given to the Owner;

\$ _____

CERTIFICATION OF EQUIVALENT PERFORMANCE AND ASSUMPTION OF LIABILITY FOR EQUIVALENT PERFORMANCE

The undersigned states that the function, appearance and quality are equivalent or superior to the specified item.

Submitted by: _____
Signature Title

Typed Name: _____

Company: _____

Signature shall be by person having authority to legally bind his firm to the above terms. Failure to provide a legally binding signature will invalidate this request.

SECTION 22 05 17 – SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves.
2. Sleeve-seal systems.
3. Grout.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes:** Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes:** ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves:** ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC-Pipe Sleeves:** ASTM D 1785, Schedule 40.
- E. Galvanized-Steel-Sheet Sleeves:** 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

2.2 SLEEVE-SEAL SYSTEMS

- A. Manufacturers:** Subject to compliance with requirements, provide products by one of the following :
- B. Retain option in first paragraph below if manufacturer's name and model number are indicated in schedules or plans on Drawings; delete option and insert manufacturer's name and model number if not included on Drawings.**
1. Advance Products & Systems, Inc.
 2. CALPICO, Inc.
 3. Metraflex Company (The).
 4. Pipeline Seal and Insulator, Inc.
 5. Proco Products, Inc.

- C. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Carbon steel.
 - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 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 (50 mm) above finished floor level.
 - 2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."

- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls above Grade:
 - a. Piping Smaller Than NPS 6 (DN 150): Cast-iron wall sleeves.
 - b. Piping NPS 6 (DN 150) and Larger: Cast-iron wall sleeves.
 - c. Exterior Concrete Walls below Grade:
 - d. Piping Smaller Than NPS 6 (DN 150): Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - e. Piping NPS 6 (DN 150) and Larger: Cast-iron wall sleeves with sleeve-seal system.
 - f. Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - 2. Concrete Slabs above Grade:
 - a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves.
 - c. Interior Partitions:
 - d. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves.
 - e. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 22 05 17

SECTION 22 05 23 – VALVES, COCKS & SPECIALTIES FOR PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Special Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. Furnish and install valves, cocks and specialties as indicated on drawings or specified herein.
- B. Valves, cocks and specialties may not be indicated in every instance on the drawings, but whether or not shown, all valves, cocks and check valves necessary to the proper operation of the system shall be furnished and installed by subcontractor in an approved manner and location. Pressure ratings given for valves are steam working pressure. Valves shall have rising stems except in locations where space is limited; in these locations non-rising stem valves of equal material and pressure class will be accepted.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 22 and to all other applicable portions of the Drawings and Specifications.

1.4 SUBMITTALS

- A. Submit manufacturer's data for review before any work is commenced.

PART 2 - PRODUCTS

2.1 BALL VALVES

- A. 2 inches and smaller for underground applications only: Flanged or welded connections, port area equal to or greater than connecting pipe diameter, class 125, two piece cast-iron body, chrome plated bronze ball, blow-out proof bronze stem, teflon seat and seals.
 - Crane
 - Nibco
 - Stockham

2.2 BUTTERFLY VALVES

- A. 2-1/2" and larger above ground with flanged, welded or mechanical joint connections -300 CWP, cast-iron body lead free with EPDM seat and aluminum-bronze disc:
 - Crane
 - Milwaukee
 - NIBCO Inc.

2.3 GATE VALVES

- A. 2" and smaller threaded or soldered valves, rising stem, iron wheel, rough brass body and trim, solid wedge disc, screwed or union bonnet and finished gland nut - 150 psi class.

Crane
Powell
Stockham

2.4 CHECK VALVES (SWING)

- A. Check valves 3" and smaller shall have a pressure rating of not less than 200 psi threaded pattern and 125 psi solder pattern, wye pattern swing check with rough brass body, finished gland nut and regrinding bronze disc.
- B. Check valves larger than 3" shall be flanged pattern, 125 psi iron body swing check with renewable brass seat, disc and trim. Check valves on primary heating hot water or chilled water piping system shall be 200 psi WP brass or ferrosteeel body swing check valves, with renewable brass seat, disc and trim.

Crane
Powell
Stockham

2.5 BALANCING COCKS

- A. Provide tight shut off balancing cocks at locations indicated on drawings.
- B. Cocks 2" and smaller, square head bronze cocks 125 psi class with check.
Crane
Powell,
or approved equal
- C. Cocks over 2", lubricated plug valves with semi-steel body 175 psi class.
Powell
ACF,
or approved equivalent
- D. Lubricated plug cocks over 6" shall have a geared or worm drive operator.

2.6 BACK FLOW PREVENTER (REDUCED PRESSURE)

- A. 3/4" to 4" size; ASSE Std. 1013, AWWA Std. C-506; unit shall have all bronze construction, stainless steel internal parts, test cocks and suitable for 175 psi supply water pressure. Unit shall be furnished with factory mounted bronze inlet strainer, union and non-rising stem gate valves (on inlet and outlet). Valve shall have an integral low inlet pressure check valve.
Golden Anderson – no substitutions
- B. 4" to 6" size; ASSE Std. 1013, AWWA Std. C-506; unit shall have iron body construction, epoxy coated internal water way, stainless steel internal parts, test cocks and stainless steel bolts. Unit shall be furnished with inlet strainer and non-rising stem gate valves (on inlet and outlet). Valve shall have an integral low inlet pressure check valve.
Golden Anderson – no substitutions

2.7 DIELECTRIC UNIONS

- A. Epco Sales, Inc., 3204 Sackett Avenue, Cleveland, Ohio; Capitol Manufacturing & Supply Company, Columbus; Patrol Valve Company, Cleveland, Ohio, or approved equal.

2.8 STEEL PIPING SYSTEM STRAINERS

- A. Malleable or cast iron, 125 psig working pressure. Free area of strainer - not less than 300 per cent cross sectional area of pipe. Strainer mesh, perforation size, and pattern as follows:

<u>Pipe Size</u>	<u>Pattern</u>	<u>Mesh or Perforation Diameter</u>
to 2 in.	threaded wye	20 mesh
2 to 4 in.	threaded wye	0.045 inch dia.
5 to 10 in.	flanged wye	0.125 inch dia.
12 in. up	flanged basket	0.125 inch dia.

2.9 COPPER PIPING SYSTEM STRAINERS

- A. Copper piping system strainers solder pattern with removable bolted flange on strainer leg. Strainer 40 mesh bronze screen, with free area of screen at least 3 times cross sectional area of pipe.

2.10 ACCESS PANELS

- A. Access panels (Milcor) Inland-Ryerson Construction Products Co., (Boico) Birmingham Ornamental Iron Co., or approved equal. Steel panels and frames shall be furnished with prime coat of rust inhibitor enamel. See plans for sizes (12 x 12) min.). Access panel styles as follows:

	<u>Milco</u>	<u>Boico</u>
Fire rated	1-1/2 hr. B. Label	1-1/2 hr. B. Label

2.11 SAFETY VALVES

- A. Safety Valves to be Manning, Maxwell & Moore, Watts Regulator, or Bell & Gossett Co., ASME rated as shown on the drawings and/or required by applicable codes.
- B. Refrigerant Safety Valves in accordance with USASI Code for refrigeration apparatus, and pipe discharge outside building.
- C. Protect water heaters with Watts, Beaton Cadwell or McDonnell Miller, combination automatic temperature and pressure relief valves (with manual lift lever). Relief capacity shall exceed input energy at 125 psig pressure and 210°F temperature.

2.12 AUTOMATIC AIR VENTS

- A. Automatic Air Vents to be equal to:

<u>(150 psig W.P)</u>	<u>(75 psig W.P)</u>
Metraflex MV-15	Maid-O-Mist 7
Crane Co. 976	Bell & Gossett 7
Sarco 13W	Hoffman 79
Armstrong 1AV	

2.13 MANUAL AIR VENTS

- A. Manual air vents shall be brass manual cock equal to Crane 700 series.

2.14 WATER HAMMER ARRESTERS

- A. Water hammer arresters (shock stops) shall be equal to those manufactured by Zurn Industries, Inc., MIFAB or Jay R. Smith Manufacturing Company.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install valves and cocks in horizontal piping with the valve stem in the vertical upright position.
- B. Install valves and cocks to provide adequate clearance to permit easy operation of the valve hand wheel and permit servicing of the valve packing.
- C. Provide blow down valve on 1-1/2" and larger strainers (except refrigerant piping). Use valve not less than 1/2 strainer blow down outlet size.

3.2 ACCESS PANELS

- A. Furnish adequate number of properly sized access panels (18" x 18" minimum size) to adequately service and maintain systems installed under each section of specifications.
- B. Access panels shall be installed and painted under other divisions of these specifications. Exact panel location shall be designated by the subcontractor performing the work of this Section.
- C. Access panels are not required in exposed grid or other types of readily removable ceilings.
- D. Access panels shall not compromise the fire rating of the wall.

3.3 SAFETY VALVES

- A. Safety valves to have valve spindle enclosure with gland seal to minimize leakage and manual lift lever to check discharge required. Cut discharge pipe from safety valve on a 45 degree angle, pipe to floor and direct toward or into floor drain (unless noted otherwise on the drawings).

3.4 AUTOMATIC AIR VENTS

- A. Install automatic air vents with inlet isolation cock at locations indicated on drawings and at high points of hot and chilled water piping systems. Pipe vent discharge to drain pan, plumbing trap or to outside of building.

3.5 WATER HAMMER ARRESTERS

- A. Install water hammer arresters (shock stops) at the locations indicated on the plans and in accordance with size and placement recommendations given in Plumbing and Drainage Institute Standard PDI-WH201.

3.6 BACKFLOW PREVENTERS

- A. Water service back flow preventers shall be installed above grade and in such a manner to prevent the discharge relief opening from becoming submerged by ground water. Provide suitable protection to prevent assembly from freezing.

END OF SECTION 22 05 23

SECTION 22 05 29 – BASIC PLUMBING MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Basic Requirements: Provisions of Section 22 0500, BASIC MECHANICAL REQUIREMENTS, are part of this Section.

1.2 SUMMARY

- A. General: Materials listed herein are general mechanical materials to be used for Division 22 sections of the specifications unless noted otherwise.

1.3 ADDITIONAL REQUIREMENTS

- A. Related Sections: This section relates to the requirements of all sections in Division 22.

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 22 0500.
- B. Comply: With the National Fire Protection Association (NFPA) Standards and other Codes and Standards as adopted by the Local Authority having Jurisdiction.
- C. ANSI: Color coding for piping systems shall comply with The American National Standards Institute, ASME A13.1-2007, "Scheme for the Identification of Piping Systems".
- D. NFPA: NFPA 704, Standard System for the Identification of the Fire Hazards of Materials for Emergency Response, 2001 Revision.
- E. Trench Safety Act: Excavation exceeding 5 feet in depth shall comply with OSHA 29 CFR Part 1926.650 Subpart P.

1.5 SUBMITTAL

- A. General: Refer to paragraph entitled "SUBMITTAL" in Section 22 0500. Include the following data:
 - 1. Manufacturers Literature:
 - a. Piping system identification markers and tags including a representative sample of each type.
 - b. Each type of pipe hanger and supporting device, including but not limited to attachment/interface to structure.
 - 2. Installation Instructions:
 - 3. Operating Instructions:
 - a. Valve tag list framed under glass and mounted in the each mechanical equipment room.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Acceptance: 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.

- B. Material: Refer to the paragraph entitled "MATERIAL AND EQUIPMENT" in Section 22 0500.

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 direction. 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 have 1/2 inch chamfered on all exposed edges and shall be poured 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. Pad shall be 4" thick, unless noted otherwise.
- 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 PAINTING AND MARKING

- A. Prohibited Material: The use of red lead or any lead-based component in primer or paint is prohibited.
- B. Marking: Refer also to sections describing identification of mechanical systems.

2.4 IDENTIFICATION OF PIPING AND EQUIPMENT

- A. General: Comply with ASME A13.1-2007, "Scheme for Identification of Piping Systems" and OSHA requirements, or as otherwise indicated.
- B. Manufacturer:
1. Refer to paragraph entitled "MANUFACTURERS" in Section 22 0500. Model numbers or product type listed for one or more manufacturers are given to provide an example of the item required.
- C. 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
¾ 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

1. Manufacturer:
 - a. Pipes 3/4 inch through 5 inch O.D.: Seton, Setmark Type SNA.
 - b. Pipes 6 inch O.D. and Greater: Seton, Setmark Type STR.
- D. 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.
 1. Manufacturer:
 - a. Brady, B-500 Vinyl Cloth, B-350 PermaCode or B-946 Outdoor Film.
- E. 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. Manufacturer: Provide either of the following types:
 - a. Brass Type: Minimum 19 gauge polished brass; 1-1/2 inch min. diameter. Seton, Style 250-BL.
 - b. Aluminum Color Coded Type: Anodized aluminum; 2 inch min. diameter. Seton, Style 2070.
 - 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. Seton, Type 4.
 - 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. Brady, Series No. 2297.
- F. 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.
 - a. Manufacturer:
 - (1) Seton, Setonite.
 2. Aluminum Type: Engraved, flexible, 0.020 inch thick aluminum. Sized 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.
 - a. Manufacturer:
 - (1) Seton, No. 06505.

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 PVC coated steel or copper, clevis type.
 2. Hangers for all other types of piping shall be as indicated on paragraph 3, 4 and 5 below, steel clevis type or split ring. Pipe hangers shall be capable of vertical adjustment after erection of the piping. Hanger rods shall be as indicated on paragraph 3, 4 and 5 below.
 3. Provide and install factory Hot Dipped Galvanized hangers and supports in when exposed to weather and exterior but under cover.
 4. Provide and install Carbon steel hangers and supports in enclosed mechanical rooms or enclosed conditioned spaces.
 5. Provide and install Electroplated Galvanized steel hangers and supports when located in enclosed, unconditioned spaces.
 6. 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 PVC coating finish or copper.
 7. Manufacturer:
 - (1) Empire

- (2) Grinnell/Anvil
 - (3) Tolco
- C. Beam Clamp: Beam clamps may be used when supporting piping from steel structures.
- D. Inserts: Concrete inserts shall be placed in forms prior to the time that concrete is poured.
- 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.
- 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. Manufacturer:
 - 1. Guarantee Specialty Mfg. Co.
 - 2. American Sanitary Mfg. Co.
 - 3. Benton & Caldwell
- C. 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 equivalent to Benton & Caldwell No. 3A chromium plated brass; for sleeves extending above floor shall be equivalent to Benton & Caldwell No. 36 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.
 - a. Manufacturer:
 - (1) Thunderline Corp., Link-Seal Type WS.
 - 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 sleeves built into wall, partition or beam, sized to pass pipe and covering, leaving a clear space of 1/4 inch minimum between covering and sleeve. Penetrations of fire rated partitions shall have mild steel sleeves.
 - 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 gauge galvanized sheet steel framed construction in roof, wall, or partitions.

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 structural or architectural 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.

3.3 PAINTING

- A. General: Paint all exposed piping, insulation, equipment, structural bases, racks, in equipment rooms and on roof, furnished under Division 22 of these specifications. All exposed metal surfaces shall be given one prime coat and two finish coats. 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 thoroughly cleaned and painted before installation and suitably protected.
- D. Concealed Items: Concealed piping need not be painted.
- E. Metal Surfaces: Use a scraper or wire brush to remove rust and roughen metal surfaces prior to painting. After wire brushing, wash surfaces to remove particulates, apply primer coat after surface is dry but not more than 48 hours after wire brushing.
- 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
F – Fire Protection Equipment	Red
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

3.4 IDENTIFICATION OF PIPING AND EQUIPMENT

- A. General: Apply after completion of insulation, painting and cleaning work so that final identification is not disfigured.
 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 and duct which are side-by-side at the same general place.) Labels on vertical piping and ductwork 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.
- B. Markers and Bands: Provide on piping as follows:
 1. Pipe Concealed in Otherwise Inaccessible Locations (e.g., Chases, non-accessible ceilings): No identification required, except at access doors.
 2. Pipe Concealed in Accessible Locations (e.g., Ceiling Plenums): Markers every 30 feet of pipe length. Bands every 15 feet of pipe length.
 3. 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.
 4. Exterior Pipe, Exposed: Markers and bands every 40 feet of pipe length.
 5. 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 this division 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 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 Architect. 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.

3.5 HANGERS AND INSERTS

- A. General: Refer also to other sections which may describe additional requirements for hanging and supporting.
- B. Location: Provide and properly locate hangers to adequately 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 22 0700, 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
12	1/2	3/4
14	3/4*	3/4
15	5/8	---
16	7/8*	7/8
18	7/8*	1
20	1*	1
24	1-1/4*	1-1/4

* 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.

3.6 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: Caulk annular space between pipe and sleeve using oakum and poured lead both sides minimum one inch deep to make wall penetration water tight or use 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.
- E. Fire and Fire/Smoke Penetrations: Protect all penetrations of rated partitions with a listed assembly for each particular rating and building material partition. Comply with the manufacturer's instructions for installation of the partition penetration protection assembly.
- F. Water Tight: Sleeves in walls and/or slabs subject to hydrostatic pressures shall be watertight.
- 3.7 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 FIRE/SMOKE RATED FLOOR, PARTITION OR WALL PENETRATIONS
- A. Fire and Fire/Smoke Penetrations: Protect all penetrations of rated partitions with a listed assembly for each particular rating and building material partition. Comply with the manufacturer's instructions for installation of the partition penetration protection assembly.

END OF SECTION 22 05 29

SECTION 22 05 53 – IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

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. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Stencils.
 - 5. Valve tags.
 - 6. Warning tags.

1.3 ACTION 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.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Letter Color: White.
 - 3. Background Color: Black.
 - 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

5. Minimum Letter Size: 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-quarters the size of principal lettering.
 6. Fasteners: Stainless-steel rivets or self-tapping screws.
 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 2. Letter Color: White.
 3. Background Color: Black.
 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 6. Minimum Letter Size: 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-quarters the size of principal lettering.
 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: Yellow.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 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-quarters the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- I. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: Size letters according to ASME A13.1 for piping.

2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link chain.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 WARNING TAGS

- A. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
 - 1. Size: Approximately 4 by 7 inches.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Safety yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

- 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 locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

- A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- C. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed 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 inaccessible 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 25 feet along each run. Reduce intervals to 10 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

- D. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- E. Pipe Label Color Schedule:
 - 1. Low-Pressure Compressed Air Piping:
 - a. Background: Safety blue.
 - b. Letter Colors: White.
 - 2. High-Pressure Compressed Air Piping:
 - a. Background: Safety blue.
 - b. Letter Colors: White.
 - 3. Domestic Water Piping
 - a. Background: Safety green.
 - b. Letter Colors: White.
 - 4. Sanitary Waste and Storm Drainage Piping:
 - a. Background Color: Safety black.
 - b. Letter Color: White.

3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. Cold Water: 2 inches, round.
 - b. Hot Water: 2 inches, round.
 - 2. Valve-Tag Colors:
 - a. Cold Water: Natural.
 - b. Hot Water: Natural.
 - 3. Letter Colors:
 - a. Cold Water: White.
 - b. Hot Water: White.

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 22 05 53

SECTION 22 07 00 – INSULATION FOR PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Special Conditions and Division-01 Specification Sections, apply to work of this section.

1.2 SCOPE

- A. Above grade domestic hot water supply and recirculating piping.
- B. Below grade domestic hot water supply and recirculating piping.
- C. Above grade waste lines and trap from ice machines, waste and storm lines receiving condensate from air conditioning units to a point of connection to a soil line receiving waste from 4 or more plumbing fixtures.
- D. Interior storm water piping.
- E. Above grade domestic cold water piping in vented attic, vented ceiling spaces and vented soffits with 3/4" fiberglass and all service jacket.
- F. Above grade exterior domestic cold water piping.
- G. Handicap lavatory exposed hot water and waste piping.
- H. Above grade fire protection piping in vented attic, vented ceiling spaces and vented soffits with 3/4" fiberglass and all service jacket.
- I. Above grade domestic chilled water piping.
- J. Below grade domestic chilled water piping.
- K. Domestic water chilled evaporator, chilled water compression or expansion tank; and other cold surfaces with operating temperatures of less than 70 degrees F.
- L. Domestic chilled water pumps.
- M. Above grade water piping exposed in unheated areas.
- N. Alternates may or may not substantially change scope and general character of the work; and must not be confused with "change orders", "substitutions", and other similar provisions.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division-22 and to all other applicable portions of the Drawings and Specifications.

1.4 SUBMITTALS

- A. Submit manufacturer's data for review before any work is commenced.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Materials listed in subsequent paragraphs of this specification are those used as basis of design; alternate manufacturer's equivalent projects as listed herein will be accepted. The insulation contractor shall verify materials and comply with requirements of NFPA 90, with regard to a flame spread rating of 25 or less and; a smoke developed/fuel contributed value of less than 50.

2.2 MATERIALS

- A. Insulation and accessory materials to be as manufactured by the listed manufacturers or approved equal:
1. Calcium Silicate: Owens Corning "Kaylo", Manville "Thermo-12".
 2. Fiberglass: Owens Corning, Knauf, CertainTeed, or Manville.
 3. Foamed Plastic Insulation: Armstrong "Armaflex", U.S. Rubber "Ensolex", Gustin Bacon "Ultra-Foam", Owens Corning "O-C" Halstead Industrial Products, or approved equal.
 4. Cellular Glass: Fed. Spec. HH-I-551a.
 5. Extruded Polyethylene Insulation: Nomaco Inc. "Thermacell, Sentinel Energy Savings Products Division of Packaging Energy Groups, Inc., "Senflex" or approved equal.
 6. Insulating Finish Cement: JM No. 301, BH Improved Super Powerhouse Cement, The Ruberoid Co., No. 412, or approved equal.
 7. Mastics, Sealers and Adhesives:

	Benjamin <u>Foster</u>	<u>Insulcoustic</u>	<u>Childers</u>	<u>J-M</u>
Cellular glass	30-45	40-10	CP-70	bedding mastic
General purpose	35-00	Series Vi AC Mastic	CP-10	375 mastic
Vapor barrier	30-35	IC-501	CP-30	sealant (indoor)
Adhesive	85-20		CP-89	
Fire retardant	60-35	IC-531		sealer (outdoor)
Foamed Plastic & Adhesive				57
Extruded Poly- Ethylene	Therma-Cel 950 Adhesive			

8. Pipe Jacketing and Valve Covers (Ultra Violet Resistant): Zeston PVC, CEEL-Tite, Proto Corp. (Lo Smoke), or approved equal.
9. Metal Jacketing and Fitting Cover: Aluminum 0.016 gage (minimum) smooth or corrugated, Childers Products Co., General Aluminum Supply Co. (Gasco), Alcorjac by Insulcoustic Co., or approved equal.
10. Molded Fiberglass Fitting Insulation: Molded Acoustical Products, Inc., West Easton, PA, 18042 or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

- A. Insulation is not to be installed until the piping systems have been checked and found free of all leaks. Surfaces shall be clean and dry before attempting to apply insulation. A professional insulator with adequate experience and ability shall install insulation.
- B. Provide hanger or pipe support shields of 16 gage (minimum) galvanized steel over or embedded in the insulation. Shield shall extend halfway up the pipe insulation cover and at least 6" on each side of the hanger. Securely fasten shield with pipe straps at each end. Insulate pipe anchors adequately to

prevent moisture condensation problems.

- C. Insulation installed in exposed locations such as but not limited to: water heater rooms, equipment rooms, air handling unit rooms, all exterior above grade areas, kitchens, power houses, utility buildings, energy building or similarly identified locations where the insulation would be subject to physical damage shall be covered with metal jacketing. Elbows may be covered with fire rated and ozone resistant (for exterior locations) PVC covers in lieu of metal jacket.

3.2 WARM OR HOT SURFACES

- A. Insulate interior warm or hot surfaces with an operating temperature of over 120 degrees F and less than 400 degrees.
- B. These surfaces include hot water storage heater.
- C. Insulate with 1-1/2" thick calcium silicate blocks, securely wired on and covered with poultry wire. Apply a finish coat of 1/2" insulating finish cement over the poultry wire. Trowel the exterior smooth.
- D. Insulate hot surfaces operating at over 100 degrees F temperature with 3/4" V-rib spacing lath and 1-1/2" molded 85% magnesia or calcium silicate blocks wired on over the spacing lath. Apply poultry wire over the magnesia blocks and give a 1/2" coat of insulating finish cement. Trowel the exterior smooth.

3.3 COLD SURFACES

- A. Cold surfaces with operating temperatures below 70 degrees F to be insulated with 1" thickness foamed plastic or extruded polyethylene insulation. Surfaces include, but not limited to, domestic water chiller, domestic chilled water air separator, domestic chilled water expansion tank, domestic chilled water pump, and refrigerant suction line intercooler. The foamed plastic sheets shall be applied over a heavy coating of Johns-Manville #57 adhesive. The insulation shall be finished with a heavy coat of white aerotube finish.

3.4 DOMESTIC CHILLED WATER PIPING

- A. Insulate domestic chilled water piping as described in these paragraphs with cellular glass. (Cellular glass with a factory applied glassfab jacket is acceptable.) Mitre cut insulation and carefully fit to the pipe fittings. Piping 6 inch and smaller, use 1-1/2" thickness insulation; piping over 6 inch diameter, use 2" thickness insulation. All cellular glass shall be shop bore-coated with Keen's cement prior to shipment to the job site. All pipe insulation joints shall be buttered with Foster's GPM 3500 or equal. The insulation sections shall be wired in place with 16 gauge copper or stainless steel wires spaced approximately 9" on center. Valves and fittings shall be insulated with prefabricated or pre-formed sections of cellular glass insulation and finished the same as adjacent piping.
- B. Finish cellular glass insulation in concealed locations by applying a heavy coat of Foster's GPM 3500 vapor barrier sealant to the exterior surface of the cellular glass. Embed a layer of open weave glass fabric cloth in this sealant overlapping seams at least 2". Apply a finish coat of Foster's GPM 3500 and finish as smooth as possible. Note: Two coats of sealer will be required where factory applied glassfab jacket is used.
- C. Finish cellular glass in exposed interior locations such as air handling unit equipment rooms, boiler rooms, and chiller room as follows:
 - 1. Straight runs of 2" piping and larger - cover with 0.016" thickness smooth aluminum weatherproof jacket with factory applied integral vapor barrier. Piping 2" and smaller - 0.010" thickness aluminum jacket with integral vapor barrier. Seal joints to preserve integrity of vapor barrier. Fasten jacket with 1/2" wide aluminum bands on not over 12" centers. Elbows, tees, reducers, valves and other special fittings - use prefab jacket.

3.5 ABOVE GROUND DOMESTIC HOT WATER AND DOMESTIC HOT WATER RECIRCULATION PIPING

- A. Shall be insulated with ASJ fiberglass pipe insulation. Prior to installing the insulation, the pressure release paper shall be removed from the jacket laps. The insulation shall be secured in place by applying pressure to the pressure sensitive closure system. All fittings shall be insulated with molded fiberglass pipe insulation segments and finished with Foster's 30-35 vapor barrier coating or equal, reinforced with a layer of white open weave glass fabric.
- B. Main pipe sizes 2-1/2" and smaller shall have 1" thickness insulation unless noted on the drawings.
- C. Pipe sizes 2-1/2" and larger shall have 1-1/2" thickness insulation.
- D. Branch runouts up to 2" shall have 1/2" thickness insulation.

3.6 HANDICAP LAVATORY EXPOSED HOT WATER AND WASTE PIPING

- A. Shall be insulated with foamed plastic insulation or extruded polyethylene, one-half inch thickness.
- B. Mitre cut insulation to fit the pipe, fittings and stops.
- C. Use approved cement to seal all joints, seams, and end in the insulation.

END OF SECTION 22 07 00

PART 1 - SECTION 221000 – PLUMBING PIPING SYSTEMS

PART 2 - PART 1 - GENERAL

2.1 RELATED DOCUMENTS

- A. Basic Requirements: Provisions of Section 22 0500, BASIC PLUMBING REQUIREMENTS, are a part of this Section.

2.2 SUMMARY

- A. General: Provide domestic water piping, drainage waste and vent piping, and other plumbing piping and appurtenances as indicated.

2.3 ADDITIONAL REQUIREMENTS

- A. Related Sections: Other Sections of Division 22 which relate to the requirements of this Section may include but are not limited to the following:
 - 1. 22 0529, BASIC PLUMBING MATERIALS AND METHODS
 - 2. 22 2114, PLUMBING PIPE AND FITTINGS
 - 3. 22 0519, PLUMBING PIPING SPECIALTIES
 - 4. 22 0523, PLUMBING VALVES
 - 5. 22 0700, PLUMBING THERMAL INSULATION
 - 6. 22 3300, PLUMBING EQUIPMENT
 - 7. 22 4000, PLUMBING FIXTURES
 - 8.
- B. Related Divisions: Other Divisions or Sections of these specifications which relate to the requirements of this Section may include but are not limited to the following:
 - 1. Division 1, ALTERNATES
 - 2.

2.4 SUBMITTALS

- A. General: Refer to paragraph entitled "SUBMITTAL" in Section 22 0500. Provide shop drawing and/or manufacturer's data sheet for the following items:
 - 1. Manufacturers Literature:
 - a. Dimensional outline drawing for all plumbing valves and products.
 - b. Complete list of all piping materials to be used in this section including valves and method of connection for each piping system.
 - c.

2.5 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 22 0500.
- B.
- C. Domestic Water System: All system components that come in contact with potable water systems shall be certified under ANSI/NSF Standards 60 and 61.
- D.

PART 3 - PRODUCTS

3.1 GENERAL

- A. Application: The plumbing piping system shall only be of the materials indicated. Refer to Section 23 2114, PIPE AND FITTINGS, and Section 22 0700, THERMAL INSULATION, for material specifications. 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.
- C. Valves: All valves used in the plumbing piping shall be 125 psi SWP, 200 psi WOG as specified in Section 23 0523, VALVES.
- D. Manufacturer: Refer to paragraph entitled "MANUFACTURERS" in Section 22 0500.
- E.
- F. Dielectric Connections: Provide approved connections for dissimilar materials per 22 2114.

3.2 DOMESTIC WATER PIPE

- A. Above and Below Ground:
 - 1. Piping 4 inches and smaller shall be copper tube, Type K.
 - 2.

3.3 SANITARY WASTE AND VENT PIPING

- A. Above Ground:
 - 1. Cast iron soil pipe, service weight.
 - 2. No-Hub: Joints shall be "No-hub" type coupling consisting of a 24 gauge 304 stainless steel compression clamp with gasket guides, 304 stainless steel screw clamp, and matching full neoprene gasket that interlocks with the housing. Fittings shall conform to CISPI Standard 310 unless noted otherwise. Maximum size allowable is 15 inches.
 - a. Manufacturer: Husky, Inc., Orange shield SD 4000.
 - 3.

B.

3.4 CONDENSATE DRAIN PIPING

- A. General: Unless otherwise specifically noted condensate drain piping shall be copper tube, Type L.
 - 1.

3.5 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 pre-formed pipe insulation as follows:
 - 1. Domestic Hot Water:
 - a. Fiberglass
 - b. Polymer Foam
 - 2. Condensate Drain:

- a. Elastomeric
- b.
- B. Thickness: The insulation thickness in inches shall be in accordance with the following table:
- C.
- D.

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
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
Storm Water	1	1	1	1	1*

* (Or manufacturer's minimum thickness based on the pipe size.)

- E. Exposed: For piping, other than domestic cold water, exposed to the outdoor air or in an unconditioned space or cellar area, increase insulation thickness by 1/2 inch.
- F.

3.6 VALVES

- A. General: Refer to the requirements of Section 22 0523, VALVES, for the complete requirements of all valves indicated in this section.
- B.
- C. 4 inch and smaller: Valves 4 inch and smaller shall be full port valves with bronze or brass body and bronze trim, threaded or soldered connections.
- D. Butterfly and gate valves shall not be permitted on domestic water systems. No quarter turn stop valves shall be used.
- E. Domestic hot water recirculation systems shall be controlled with ball type/or auto flow control valves.
- F. Underground: Valves underground shall be gate-type with cast iron body and bronze trim, flanged or welded connections, and non-rising stem with square wrench nut head.
 - 1. Acceptable Manufacturers: Stockham, U.S. Pipe Metroseal, Kennedy
 - 2.

3.7 HANGERS

- A. Reference Section 22 0529 for Basic Hanger Materials and Spacing Requirements.
- B.
- C. Additional Plumbing Hanger Requirements:
 - 1. Copper piping installed within metal stud walls shall be supported with manufactured isolators. Isolators shall be Pipe-Tytes, Holdrite, B-line.
 - 2. Standard pipe clamp are not acceptable. Provide with metal type as needed for copper.
 - 3. Provide suspension pipe clamps on metal stud walls only.
 - 4. Provide telescoping mounting brackets on stud walls. B-line, Holdrite.
 - 5. Universal bracketing system and universal pipe clamp are not acceptable.
 - 6. Plastic straps are not acceptable. Temporary usage only.

7. Non-insulated copper pipes installed on trapeze hangers shall have isolation clamps. B-Line, "Vibra Cushion", "Vibraclamp", Anvil or approved equivalent shall be provided. Wrapping the pipe with tape shall not be acceptable
- 8.
- 9.

PART 4 - EXECUTION

4.1 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 15 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.
- D. 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.
- E. 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.
- F. Vent Flashing: Refer to architectural details and specifications for proper flashing requirements of vent piping through the roof.

4.2 INSULATION

- A. Horizontal Storm Water: Insulation shall begin at the base of the roof and overflow drain body and include all horizontal piping and elbows at change of directions from the horizontal to the vertical.
- B.
- C. Condensate Piping: Insulate condensate piping and waste lines from ice machines with a minimum of 1/2 inch thickness elastomeric insulation.
- D. Hub drains, floor drains and traps: Insulate all hub drains, floor drain and floor drain traps receiving condensate with 1" fiberglass insulation. Insulation shall begin at the base of drains, include the p-trap and all horizontal piping and elbows at change of directions from the horizontal to the vertical.
- E. Roof drains and bodies: Insulate all roof drain bodies receiving condensate with 1" fiberglass insulation. Insulation shall begin at the base of the roof drain and include all horizontal piping and elbows at change of directions from the horizontal to the vertical.

4.3 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.
- 3.
- B. Storm Water Piping: Sanitary piping test shall be used for storm water piping.
- C.
- D. Condensate Drain Piping: Sanitary piping test shall be used for condensate drain piping
- E. Domestic Water Piping: Pressure testing and sterilization shall be performed as described in Section 22 2114, PIPE AND FITTINGS.

END OF SECTION 22 10 00

SECTION 22 11 16 - PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Special Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. The work pertaining to this Division occurs within the confines of the building line, and within a boundary outside of the building line for a distance of five (5) feet, measured normal to the building line, or as indicated on the drawings.
- B. Alternates may or may not substantially change scope and general character of the work; and must not be confused with "change orders", "substitutions", and other similar provisions.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 22 and to all other applicable portions of the Drawings and Specifications.

1.4 SUBMITTALS

- A. Submit manufacturer's data for review before any work is commenced.

PART 2 - PRODUCTS

2.1 PIPING SPECIALTIES

- A. Where it is desirable or necessary to support the pipe hangers to concrete, inserts shall be placed in the forms by the Mechanical Contractor prior to the time concrete is poured.
- B. Lead tamp-ins may be used when installed in a concrete or masonry wall or other like vertical surface to support a vertical hanger. Lead tamp-ins will not be permitted to support hangers to the underside of concrete slab.
- C. For parallel runs of above ground suspended piping, an acceptable trapeze-type hanger may be used. Provide permanent, non-conductive type wrapping between copper pipe and steel trapeze hangers.
- D. Pipes passing through walls, floors shall have sleeves of the same materials as the pipe. Sleeves shall allow insulated pipes to pass without changing the insulation thickness. Clearance around sleeves shall be packed with glass fiber after completion of pipe work. Sleeves in all floor slabs except slabs on grade shall have pipe sleeves extended 1 inch above finish floor to prevent water from running through sleeves to area below. Make watertight, caulk with sealant around each sleeve.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The contractor shall furnish all labor, materials, *including gases* equipment and instruments required to conduct tests of piping systems. Tests shall be as herein called for.

- B. PVC piping, fittings and other PVC materials shall not be installed in air conditioning plenums or equipment rooms used as air conditioning plenums.
- C. Tests shall be conducted and the inspection of the piping shall be made in the presence of the Architect and/or Engineers.
- D. Material and/or joints found defective shall be replaced and/or corrected and additional tests shall be conducted after correction of work.

3.2 PIPE SIZING, DRAWINGS AND SPECIFICATIONS

- A. It is intended that work covered by these specifications and drawings include everything requisite and necessary to make the various systems complete and operative, irrespective of whether or not every item is specifically provided for. Any omission of direct reference herein to any essential item shall not excuse contractor from complying with the above intent.
- B. Figured dimensions supersede scaled ones. Contractor shall take no advantage of, and shall promptly call the Owner's Representative's attention to any error, omission or inconsistency in specifications and drawings.
- C. Special attention is directed to requirements that equipment and materials stated in specifications and/or indicated on drawings shall be furnished, except if otherwise noted, completely installed, adjusted and left in safe and satisfactory operating condition. Accessories, appliances and connections necessary for operation of equipment shall be provided to satisfaction of the Owner's Representative.
- D. Materials, apparatus or equipment specified or otherwise provided for on drawings, addenda, or change orders issued subsequent to award of contract shall be same brand, type, quality and character originally specified unless otherwise provided.
- E. Layout of equipment, accessories, specialties and suspended, concealed or exposed piping systems are diagrammatic unless dimensioned. In preparing shop drawings, contractor shall check project conditions before installing work. If there are any interferences or conflicts, they shall be called to attention of the Owner's Representative immediately for clarification.
- F. The drawings indicate required size and points of termination of pipes and ducts and suggest proper routes to conform to structure, avoid obstructions and preserve clearances. However, it is not intended that drawings indicate all necessary offsets, and it shall be the work of this contractor to make the installation in such a manner as to conform to structure, avoid obstructions, preserve headroom and keep openings and passageways clear, without further obstruction or cost to the Owner.
- G. Shop drawings shall be furnished by this contractor, indicating all changes to meet space requirements, code requirements and as necessary to resolve all space conflicts.
- H. It is intended that all apparatus be located symmetrical with architectural elements, and shall be installed at exact height and locations as shown on the architectural drawings. Refer to architectural details in completing and correlating work.
- I. The contractor shall fully inform himself regarding any and all peculiarities and limitations of the spaces available for the installation of all work and materials furnished and installed under the contract, prior to submitting his bid. He shall exercise due and particular caution to determine that all parts of his work are made quickly and easily accessible.
- J. The contractor shall carefully examine any existing conditions, existing piping and ducts and premises and compare the drawing with the existing conditions, prior to submitting his bid.

- K. It cannot be too strongly emphasized that, except for work specifically excluded herein, every system shall be turned over to Owner installed completed, with components, ready for normal operation.
- L. In addition to work shown on mechanical drawings, see Architectural Drawings for existing work to be removed, relocated and/or modified. Modify existing systems by rerouting for systems to remain or remove the abandoned systems as required to accommodate new general construction, plumbing, electrical and mechanical work.
- M. Pipe sizes shall be minimum as allowed by local codes or as shown on the drawings, whichever is larger.

END OF SECTION 22 11 16

SECTION 22 11 19 – DOMESTIC COLD & HOT WATER SUPPLY PIPING & HOT WATER CIRCULATING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Special Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. The work pertaining to this Division occurs within the confines of the building line, and within a boundary outside of the building line for a distance of five (5) feet, measured normal to the building line, or as indicated on the drawings.
- B. Alternates may or may not substantially change scope and general character of the work; and must not be confused with "change orders", "substitutions", and other similar provisions.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 22 and to all other applicable portions of the Drawings and Specifications.

1.4 SUBMITTALS

- A. Submit manufacturer's data for review before any work is commenced.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide valves and specialties as specified under additional Sections of this Specification.

2.2 PIPE

- A. The following schedule covers materials unless otherwise specified under a particular System Section.
 - 1. Copper tube, Type K, hard temper, ASTM B 88. For above ground.
 - 2. Copper tube, Type K, soft drawn, ASTM B 88. For below ground.
 - 3. Copper tube, Type L, hard drawn, ASTM B 88. For condensate waste only.
 - 4. Brass pipe or tube, chrome plated.

2.3 FITTINGS

- A. Steel Pipe: Malleable iron 150 lb. banded, galvanized to match pipe.
- B. Copper Tube: Wrought or cast brass solder joint.
- C. The 'T' drill extruded fitting method may not be used.
- D. Service material shall be brass compression fittings-angle ball cocks, ball corporations, etc. Flared fittings are acceptable under controlled conditions.

2.4 PIPE JOINTS

- A. Joints in copper piping shall be made with tin-antimony solder (95-5) and non-acid flux. Contractor shall furnish manufacturers literature documenting that the lead content (trace quantities) are within the guidelines of the local codes having jurisdiction as well as the Safe Drinking Water Act Amendment (SDWAA).
- B. Joints in threaded piping shall be made with Teflon tape or non-hardening pipe compound (Seal-tite).

PART 3 - EXECUTION

3.1 GENERAL

- A. The design drawings are generally diagrammatic. They do not show every bend, off-set, elbow or other fitting which may be required in the piping for installation in the space allotted. Careful coordination of the work is necessary to avoid conflicts.
- B. Run all water lines parallel or perpendicular to building lines.
- C. For piping requiring insulation, lay out and carefully install piping with sufficient clearances to permit proper application of the insulation. If the piping is such that a neat insulation job cannot be obtained with reasonable effort, the piping subcontractor shall relocate piping.
- D. Separate underground water piping and building sewer with undisturbed or compacted earth at least 10' horizontally if installed at the same level or lower than the sewer. Where water piping is closer than 10' to a sewer, place the bottom of the water pipe at least 18" above the top of the sewer, or the sewer shall be encased in a concrete envelope as required by the Department of Health & Rehabilitative Services (State of Florida).
- E. Minimum cover for exterior underground piping is three feet over insulation or conduit unless otherwise noted on plans. Carefully excavate trench to smooth finished surface; if cut is too deep, backfill with clean earth and hand tamp to compact bottom. Make depression at joints to receive flanges, collars, and couplings. Provide continuous support for pipe or conduit. Backfill to be clean earth, free of rocks and debris completely enveloping pipe or conduit on both sides and top to a minimum thickness of 6". Carefully hand tamp backfill in 6" layers until 24" has been deposited over pipe or conduit.
- F. Place color coded 6" wide 0.004" thickness polyethylene printed plastic identification tape directly above all underground piping systems approximately 12" below finished grade. Tapes shall be continuously printed with "CAUTION" in large bold letters. Printed second line with type of service below. Yellow tape is to be used for water, (Print type of water on tape; i.e., domestic cold water.)

3.2 HANGERS AND SUPPORTS

- A. Vertical Piping shall be supported at its base and no greater than every story height.
- B. Horizontal Piping (Suspended) shall be supported at not more than eight (8) foot intervals. Supports shall be adequate to maintain alignment and prevent sagging.
- C. Supports shall be connected to the building structure not from other equipment, ducts or conduits.

3.3 JOINTING PIPE

- A. All pipe lines shall be correctly aligned before joints are made.

- B. Squarely cut pipe and properly ream to remove all constriction and burrs before making up the joints.
- C. Threaded Pipe: Ream all pipe after cutting and before threading. Use non-hardening pipe compound or tape on male threads only at each joint and tighten joint to leave not more than 3 threads exposed.
- D. Copper Tube: Ream all pipe after cutting squarely, clean outside of tube ends and inside of fittings and tin end to be soldered. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.
- E. Provide nipples of same material and weight as pipe used. Provide extra strong nipples when length of unthreaded part of standard weight nipple is less than 1-1/2".
- F. Run water supply main to point indicated on plans.

3.4 WATER HAMMER ARRESTERS

- A. Water hammer arresters (shock stops) shall be installed at the locations on the plans and in accordance with PDI Standard WH-201. Provide access panels so located to permit ease of service.

3.5 VALVES

- A. Provide valves to isolate each riser, and branch line. See also Section 220523 for requirements.

3.6 REDUCERS

- A. Screwed bushings are prohibited, except where available space prevents use of reducing couplings. Pipe reductions on horizontal, hot water piping shall be made with eccentric reducers. Top of hot water piping shall be flat for venting.

3.7 TESTS

- A. Apply a water pressure test to all parts of the water supply system before the piping is concealed and before the fixtures and equipment are connected. Use a hydrostatic pressure of not less than 100 psig or 150% of system operating pressure, applied to the system for a period of four hours. There shall be no leaks at any point in the system at this pressure.
- B. 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 approved. Make repairs of defects that are discovered as a result of inspection or tests with new materials. Caulking, welding or other such sealing methods of screwed joints, cracks or holes will not be accepted. Repeat tests after defects have been eliminated.
- C. Complete all field testing prior to insulation, wrapping and/or backfill.

3.8 STERILIZATION

- A. As soon as the water piping has been thoroughly flushed out, sterilize the lines by introducing into them a solution of calcium hypochlorite or chloride of lime. Open and close all valves while system is being chlorinated. After the sterilizing agent has been applied for 24 hours, test for residual chlorine at

the ends of the lines. If less than 10 parts per million is indicated, repeat the process. When tests show at least 10 parts per million of residual chlorine, flush out the system until all traces of the chemical used are removed. Make necessary connections to sterilized piping.

3.9 PIPE PROTECTIONS

- A. Paint all uninsulated piping underground with two coats of asphaltic paint. (Manual wiping is not acceptable)
- B. Wrap pipe that touches metal or is exposed to masonry with a layer of 6 mil polyene film or 15 lb. felt.
- C. Spirally wrap all pipe lines embedded in concrete with two layers of 30 lb. felt.
- D. All exposed threads on galvanized steel pipe after assembly with two coats of zinc chromate. Remove pipe thread lubricants prior to applying paint.

END OF SECTION 22 11 19

SECTION 22 13 16 – SANITARY SEWER, STORM WATER & SANITARY VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Special Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. The work pertaining to this Division occurs within the confines of the building line, and within a boundary outside of the building line for a distance of five (5) feet, measured normal to the building line, or as indicated on the drawings.
- B. Alternates may or may not substantially change scope and general character of the work; and must not be confused with "change orders", "substitutions", and other similar provisions.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 22 and to all other applicable portions of the Drawings and Specifications.

1.4 SUBMITTALS

- A. Submit manufacturer's data for review before any work is commenced.

PART 2 - PRODUCTS

2.1 MATERIAL

- A. The following schedule covers materials unless otherwise specified under a particular System Section.

2.2 PIPE

- A. Cast-iron soil pipe service weight, centrifugally cast, ANSI A112.5.1. 2" Through 15" size, bell and spigot joint.
- B. Cast-iron soil pipe service weight, centrifugally cast, ANSI A112.5.1. 1-1/2" through 10" size, "non-hub" joint.
- C. Reinforced concrete pipe (RCP) 12" through 144" bell and spigot pattern with O-ring rubber gaskets, ASTM C76.
- D. Copper type DWV.
- E. Brass pipe or tube, chrome plated.
- F. PVC Type DWV, ASTM D2665-78. 1-1/2" through 6" size.

2.3 PIPING APPLICATIONS

- A. For above ground soil waste and vent piping, use any of the following materials:

1. Cast iron soil pipe service weight "NO-HUB" joints.
 2. Brass pipe or tube, chrome plated. This shall be provided for all above ground p-traps. PVC p-traps are not acceptable.
 3. For encasement in concrete walls and columns will be Schedule 40 PVC
- B. For below ground soil waste and vent piping, use any of the following materials:
1. Sanitary waste:
 - a. Cast iron soil pipe service weight bell and spigot.
 - b. (Note: In HVAC plenums, PVC piping shall not be installed.)
 - c. PVC Type DWV.
 2. Storm (Refer to size limitation in Section 2.2):
 - a. Cast iron soil pipe service weight bell and spigot.
 - b. PVC Type DWV.

2.4 FITTINGS

- A. Cast-Iron Soil Pipe:
1. Underground: Provide fittings of same weight and manufacture as pipe in which installed. Joints shall be bell and spigot push-on type neoprene gasket type unless noted otherwise on drawings.
 2. Above ground and in buildings: "NO-HUB" type conforming to CIPI Standard 301 unless noted otherwise on the drawings.
- B. Threaded Drainage Pipe: Cast-iron, recessed.
- C. Copper DWV: Cast or wrought solder joint DWV drainage fittings. Copper is not acceptable for vent system.
- D. PVC Type DWV: ASTM D-2665, NSF Seal of Approval, Solvent-cement joint.

2.5 PIPE JOINTS

- A. Bell and spigot type joint shall be made with push-on compression type, neoprene gasket conforming to ASTM A-74.
- B. No-hub type joints shall be constructed of 24 gage type 304 stainless steel, with gasket guides, type 304 stainless steel screw clamp, and matching neoprene (ASTM C-564) gasket that shall interlock with housing.
1. Manufacturer: Husky, Inc., Orange shield SD 4000.
- C. Joints in copper piping shall be made with tin-antimony solder (95-5) silver solder and non-acid flux.
- D. Joints in threaded piping shall be made with teflon tape or non hardening pipe compound (Seal-tite).

2.6 VENT FLASHING

- A. Furnish 4 lb. lead flashing, material as recommended by roofing system manufacturer, or copper pitch pans for all vents through the roof. Type of flashing used shall be compatible with piping material.

2.7 IDENTIFICATION

- A. Below grade piping identification and warning tape shall be 0.004 inch thick polyethylene, printed with a continuous two line message. Tapes used for non magnetic piping materials shall have a metallic core. Acceptable manufacturer is Seton Name Plate Corporation or approved equal.
- B. Above ground piping identification tape shall conform to ANSI and ASME A13.1 2007.

PART 3 - EXECUTION

3.1 GENERAL

- A. The design drawings are generally diagrammatic. They do not show every bend, off-set, elbow or other fitting which may be required in the piping for installation in the space allotted. Careful coordination of the work is necessary to avoid conflicts.
- B. PVC piping, fittings and other PVC materials shall not be installed in air conditioning plenums or equipment rooms used as air conditioning plenums.
- C. Joints and connections shall be made permanent and watertight.
- D. Run piping to sewer connection point outside of building or as indicated on drawings.
- E. Install 3" and larger horizontal soil and waste piping to 1/8" per foot slope. Piping 2" and smaller shall be installed at a slope of 1/4" per foot. Run horizontal vent lines to a minimum grade back to stacks and vertical vent lines as direct and free from bends as possible.
- F. For piping requiring insulation, lay out and carefully install piping with sufficient clearances to permit proper application of the insulation. If the piping is such that a neat insulation job cannot be obtained with reasonable effort, the piping subcontractor shall relocate piping.
- G. Separate underground water piping and building sewer with undisturbed or compacted earth at least 10' horizontally if installed at the same level or lower than the sewer. Where water piping is closer than 10' to a sewer, place the bottom of the water pipe at least 18" above the top of the sewer, or the sewer shall be encased in a concrete envelope as required by the Department of Health & Rehabilitative Services (State of Florida).
- H. Minimum cover for exterior underground piping is three feet over conduit unless otherwise noted on plans. Carefully excavate trench to smooth finished surface; if cut is too deep, backfill with clean earth and hand tamp to compact bottom. Make depression at joints to receive bells, collars, and couplings. Provide continuous support for pipe or conduit. Backfill to be clean earth, free of rocks and debris completely enveloping pipe or conduit on both sides and top to a minimum thickness of 6". Carefully hand tamp backfill in 6" layers until 18" has been deposited over pipe or conduit.
- I. Place color coded 6" wide 0.004" thickness polyethylene printed plastic identification tape directly above all underground piping systems approximately 12" below finished grade. Tapes shall be continuously printed with "CAUTION" in large bold letters. Printed second line with type of service below. Red tape is to be used for sewer, (Print type of water on tape; i.e., storm water.)
- J. Where condensate piping is indicated, piping shall be extended to the nearest catch basin/yard drain. A cast iron back water valve shall be provided with epoxy-coated steel access housing.

3.2 HANGERS AND SUPPORTS

- A. Vertical Piping shall be supported at its base and no greater than every story height, not to exceed 20 foot intervals.
- B. Horizontal Piping (Suspended) shall be supported at each bend; at not more than five (5) foot intervals; except that pipe exceeding five (5) feet in length may be supported at not more than ten (10) foot intervals. Supports shall be adequate to maintain alignment and prevent sagging and shall be made directly behind the bell or coupling, where possible, not near the center of the pipe.
- C. Supports shall be connected to the building structure not from other equipment, ducts or conduits.

- D. Horizontal pipe and fittings six inches and larger shall be suitably braced to prevent horizontal movement. This should be done at every branch opening or change of direction by the use of braces, blocks, rodding or other suitable method, to prevent movement.
- E. Where components are suspended in excess of eighteen inches by means of non-rigid hangers, they should be suitably braced against movement horizontally, often called sway bracing.

3.3 LINE AND GRADE

- A. Install gravity lines at uniform grade to low point after field verification of low point invert.
- B. Run piping straight, plumb and grade in the direction indicated on the drawings.

3.4 JOINTING PIPE

- A. All pipe lines shall be correctly aligned before joints are made.
- B. Squarely cut pipe and properly ream to remove all constriction and burrs before making up the joints.
- C. Threaded Pipe: Ream all pipe after cutting and before threading. Use non-hardening pipe compound on male threads only at each joint and tighten joint to leave not more than 3 threads exposed.
- D. Copper Tube: Ream all pipe after cutting squarely, clean outside of tube ends and inside of fittings and tin end to be soldered. Apply non-acid solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.
- E. Joining "NO-HUB" cast iron soil pipe and fittings shall be in accordance with recommended practices described by the coupling manufacturers.
- F. Provide nipples of same material and weight as pipe used. Provide extra strong nipples when length of unthreaded part of standard weight nipple is less than 1-1/2".
- G. Provide reducing fittings (reducing bushings shall not be used) where changes in pipe sizes occur.
- H. Provide dielectric unions or flanges between copper and steel piping and between brassware and steel. Do not use steel and copper piping in the same system without such isolation.

3.5 PIPE PROTECTION

- A. Paint all uninsulated piping underground (except cast iron) with two coats of asphaltic paint (Manual wiping is not acceptable).
- B. Wrap soil pipe that touches metal or is exposed to masonry with a layer of 6 mil polyene film or 15 lb. roofing felt.
- C. Spirally wrap all pipe lines embedded in concrete with two layers of 30 lb. roofing felt.

3.6 TESTS

- A. A water test shall be applied to the sanitary and storm drainage systems either in its entirety or in sections. 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 openings of the section under test, and each section shall be filled with water, but no section shall be tested with less than 10 ft. head of water. In testing successive sections at least the upper 10 ft of the next preceding section shall be

tested, so that no joint or pipe in the building (except the uppermost 10 ft of the system) shall have been submitted to a test of less than a 10 ft head of water. The water shall be kept in the system, or in the portion under test, for at least 30 minutes before inspection starts; the system shall then be tight at all points.

- B. An air test shall be made by attaching an air compressor or testing apparatus to any suitable 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 or sufficient to balance a column of mercury ten inches in height. This pressure shall be held without introduction of additional air for a period of at least 30 minutes.
- C. Complete all field testing prior to insulation, wrapping and/or backfill.

END OF SECTION 22 13 16

SECTION 22 13 17 – CLEANOUTS & CLEANOUT ACCESS COVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Special Conditions and Division-01 Specification sections, apply to work of this section.
- B. Alternates may be or may not substantially change scope and general character of the work; and must not be confused with "change orders", "substitutions", and other similar provisions.

1.2 SCOPE

- A. Furnish and install cleanouts as shown on drawing or specified herein.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 22 and to all other applicable portions of the Drawings and Specifications.

1.4 SUBMITTALS

- A. Submit manufacturer's data for review before any work is commenced.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleanouts and cleanout access covers shall be of the type and materials as scheduled on the drawings.
- B. Provide all necessary bolts and appurtenances to affect a complete installation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all cleanouts and cleanout access covers in accordance with the manufacturer's instructions.
- B. Cleanouts shall be of the same nominal size as the pipes to which they are connected up to 4" in diameter; and not less than 4" for larger pipes.
- C. Cleanouts shall be provided at not more than 50 feet apart in horizontal drainage lines of 4" nominal diameter, and at not more than 75 feet apart for larger diameter pipe.
- D. At change in direction: Cleanouts shall be provided at each change of direction of the building drain when the angle of change is 90 degrees.
- E. At base of stacks: Cleanouts shall be provided at or near the base of each vertical stack.
- F. Direction of cleanout: All cleanouts shall be installed so that the cleanout opens in a direction opposite to the flow of the drainage line, or at a right angle to the line.

- G. Concealed cleanouts in wall shall be provided with removable access panel.

END OF SECTION 22 13 17

SECTION 22 13 21 – DRAINAGE & VENT SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SUMMARY

- A. This Section specifies building sanitary and vent piping systems.
- B. Related Sections:
 - 1. Separate sections in Division-02 specify sanitary sewage systems, and trenching and backfilling.
 - 2. Separate sections in Division-07 specify flashing and sheet metal and joint sealers.
 - 3. Division-23 Basic Mechanical Requirements section applies to the work of this section.
 - 4. Separate sections of Division-22 specify Basic Piping Materials and Methods, Hangers and Supports, Expansion Compensation, piping system requirements, pipe insulation, and plumbing equipment.

1.3 DEFINITIONS

- A. Drainage System: Includes all the piping within a public or private premises which conveys sewage or other liquid wastes to a point of disposal. It does not include the mains of public sewer systems or a private or public sewage treatment or disposal plant.
- B. Vent System: A pipe or pipes installed to provide a flow of air to or from a drainage system, or to provide a circulation of air within such system to protect trap seals from siphonage and back pressure.

1.4 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. Plumbing Code Compliance: Comply with applicable portions of the Florida Building Code.

1.5 SEQUENCING AND SCHEDULING

- A. Coordinate the installation of flashing and roof penetrations.
- B. Coordinate flashing materials installation of roofing, waterproofing, and adjoining substrate work.
- C. Coordinate with installation of sanitary and storm sewer systems as necessary to interface building drains with drainage piping systems.
- D. Coordinate the installation of drains in poured-in-place concrete slabs, to include proper drain elevations, installation of flashing, and slope of slab to drains.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer Uniformity: Conform with the requirements specified in Basic Mechanical Requirements.

- B. Drainage Piping Specialties, including expansion joints, drains, trap primers, and vandal-proof vent caps:
 - 1. Josam Mfg. Co.
 - 2. Zurn Ind., Inc; Hydromechanics Div.
 - 3. Wade Division, Tyler Pipe

2.2 ABOVE GROUND DRAINAGE AND VENT PIPE AND FITTINGS

- A. Hubless cast-iron soil pipe: Conform to CISPI Standard 301 and ASTM A-888, Service weight, cast-iron soil pipe and fittings, with neoprene gaskets conforming to CISPI Standard 310.
- B. Hubless joints will be no-hub type coupling consisting of a 24 gauge 304 stainless steel compression clamp with gasket guides, 304 stainless steel screw clamp and matching full neoprene gasket that interlocks with the housing. Will comply with the requirements of CISPI 310 and ASTM C-564.
- C. Maximum size allowed for no-hub piping is 8 inch.
- D. Exposed storm piping shall be cast-iron hub and spigot and joints will be installed with compression gaskets conforming the requirements of ASTM C0564.
- E. Concealed in chase rain water leader piping above grade may be Schedule 40 PVC meeting AWWA C900 Class 100. Joints shall be mechanical using elastomeric gaskets. Use of PVC in return air plenums (ie, office area) and through fire rated assemblies will not be permitted.

2.3 UNDERGROUND BUILDING DRAIN PIPE AND FITTINGS

- A. Pipe sizes 15" and smaller: Cast-iron soil pipe. Conform to ASTM A74, for Extra-Heavy weight, hub-and-spigot soil pipe and fittings, with neoprene compression gasket joints conforming to ASTM C564. Pipe and fittings shall have a heavy coating of coal tar varnish or asphaltum on both inside and outside surfaces.
- B. PVC is acceptable underground only.

2.4 DRAINAGE PIPING SPECIALTIES

- A. Trap Primers: Bronze body valve with automatic vacuum breaker, with ½" connections matching piping system, complying with ASSE 1018.
- B. Expansion Joints: Cast-iron body with adjustable bronze sleeve, bronze bolts with wing nuts.
- C. Cleanout Plugs: Cast-bronze or brass, threads complying with ANSI B2.1, countersunk head.
- D. Floor Cleanouts: Cast-iron body and frame, with clean-out plug and adjustable round top as follows:
 - 1. Nickel-Bronze Top: Manufacturer's standard cast unit with a standard non-slip scored or abrasive finish.
 - 2. Cast-iron Top: Manufacturer's standard cast unit with a standard non-slip scored or abrasive finish.
- E. Wall Cleanouts: Cast-iron body adaptable to pipe with cast-bronze or brass cleanout plug; stainless steel cover including screws.
- F. Flashing Flanges: Cast-iron watertight stack or wall sleeve with membrane flashing ring. Provide under-deck clamp and sleeve length as required.

- G. Vent Flashing Sleeves: Cast-iron caulking type roof coupling for cast-iron stacks, cast-iron threaded type roof coupling for steel stacks, and cast-bronze stack flashing sleeve for copper tubing.
- H. Floor Drains:
 - 1. Floor drain type designations and sizes are indicated on Drawings; See fixture schedules.
- I. Roof Drain:
 - 1. Roof drain type designations and sizes are indicated on the drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify all dimensions by field measurements. Verify that all drainage and vent piping and specialties may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.
- B. Verify all existing grades, inverts, utilities, obstacles, and topographical conditions prior to installations.
- C. Examine rough-in requirements for plumbing fixtures and other equipment having drain connections to verify actual locations of piping connections prior to installation.
- D. Examine walls, floors, roof, and plumbing chases for suitable conditions where piping and specialties are to be installed.
- E. Do not proceed until unsatisfactory conditions have been corrected.

3.2 JOINING PIPES AND FITTINGS

- A. Copper Tubing: Solder joints in accordance with the procedures specified in ANSI B9.1.
- B. Cast-Iron Soil Pipe: Make lead and oakum caulked joints, compression joints, and hubless joints in accordance with the recommendations in the CISPI Cast Iron Soil Pipe and Fittings Handbook, Chapter IV.

3.3 INSTALLATION

- A. Refer to the separate Division-22 section: Basic Piping Materials and Methods, for general piping installation instructions.
- B. Install supports and anchors in accordance with Division-23 Basic Mechanical Materials and Methods section "Supports and Anchors".
- C. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into account many design considerations. So far as practical, install piping as indicated.
- D. Make changes in direction for drainage and vent piping using appropriate 45-degree wyes, half-wyes, or long sweep quarter, sixth, eighth, or sixteenth bends. Sanitary tees or short quarter bends may be used on vertical stacks of drainage lines where the change in direction of flow is from horizontal to vertical, except use long-turn tees where two fixtures are installed back to back and have a common drain. Straight tees, elbows, and crosses may be used on vent lines. No change in direction of flow greater than 90 degrees shall be made. Where different sizes of drainage pipes and fittings are connected, use proper size, standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited.

- E. Make joints of "No-Hub" cast iron soil pipe with coupling assembly using torque wrench pre-set at 60 inch pounds.
- F. Install Thrust blocks at the bottom of the waste stack, condensate stack and rain leader pipe.
- G. Install sleeve and mechanical sleeve seal through foundation wall for watertight installation.

3.4 INSTALLATION OF PIPING SPECIALTIES

- A. Install expansion joints on vertical risers as indicated and as required by the plumbing code.
- B. Above Ground Cleanouts: Install in above ground piping as indicated:
 - 1. As required by plumbing code.
 - 2. At each change in direction of piping greater than 45 degrees.
 - 3. At minimum intervals of 50' for piping 3" and smaller, 75' piping 4" and larger.
 - 4. At base of each vertical soil or waste stack.
- C. Cleanouts Covers: Install floor and wall cleanout covers for concealed piping, types as indicated.
- D. Flashing Flanges: Install flashing flange and clamping device with each stack and cleanout passing through waterproof membranes.
- E. Vent Flashing Sleeves: Install on stacks passing through roof, secure over stack flashing in accordance with manufacturer's instructions.

3.5 INSTALLATION OF TRAP PRIMERS

- A. Install trap primers with piping pitched towards drain trap, minimum of 1/8" per foot (1 percent). Adjust trap primer for proper flow.

3.6 CONNECTIONS

- A. Piping Runouts to Fixtures: Provide drainage and vent piping runouts to plumbing fixtures and drains, with approved trap, of sizes indicated; but in no case smaller than required by the plumbing code.
- B. Locate piping runouts as close as possible to bottom of floor slab supporting fixtures or drains.

3.7 FIELD QUALITY CONTROL

- A. Inspections:
 - 1. Do not enclose, cover, or put into operation drainage and vent piping system until it has been inspected and approved by the authority having jurisdiction.
 - 2. During the progress of the installation, notify the plumbing official having jurisdiction, at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.
 - a. Rough-in Inspection: Arrange for inspection of the piping system before concealed or closed-in after system is roughed-in, and prior to setting fixtures.
 - b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to insure compliance with the requirements of the plumbing code.
 - 3. Reinspections: Whenever the piping system fails to pass the test or inspection, make the required corrections, and arrange for reinspection by the plumbing official.

3.8 PIPING SYSTEM TEST

- A. Test for leaks and defects all new drainage and vent piping systems.
- B. Leave uncovered and unconcealed all new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose all such work for testing that has been covered or concealed before it has been tested and approved.
- C. Drainage and Venting System Testing Procedures:
 - 1. Rough Plumbing: Test the piping of plumbing drainage and venting systems upon completion of the rough piping installation. Tightly close all openings in the piping system, and fill with water to the point of overflow, but not less than 10 feet head of water. Water level shall not drop during the period from 15 minutes before the inspection starts, through completion of the inspection. Inspect all joints for leaks.
 - 2. Finished Plumbing: After the plumbing fixtures have been set and their traps filled with water, their connections shall be tested and proved gas and water-tight. Plug the stack openings on the roof and building drain where it leaves the building, and introduce air into the system equal to a pressure of 1" water column. Use a "U" tube or manometer inserted in the trap of a water closet to measure this pressure. Air pressure shall remain constant without the introduction of additional air throughout the period of inspection. Inspect all plumbing fixture connections for gas and water leaks.
- D. Repair all leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.

3.9 ADJUSTING AND CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Clean drain strainers, domes, and traps. Remove dirt and debris.

3.10 PROTECTION

- A. Protect drains during remainder of construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of day or whenever work stops.

END OF SECTION 22 13 21

SECTION 22 21 14 – PLUMBING PIPE AND FITTINGS

PART 1 -GENERAL

1.1 RELATED DOCUMENTS

- A. Basic Requirements: Provisions of Section 22 0500, 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 ADDITIONAL REQUIREMENTS

- A. Related Sections: Other Sections of Division 23 which relate to the requirements of this Section may include but are not limited to the following:
 - 1. 22 0529, BASIC PLUMBING MATERIALS AND METHODS
 - 2. 22 0523, PLUMBING VALVES
 - 3. 22 0700, PLUMBING THERMAL INSULATION

1.4 SUBMITTAL

- A. General: Refer to paragraph entitled "SUBMITTAL" in Section 22 0500. Provide shop drawing and/or manufacturer's data sheet for the following items:
 - 1. Manufacturers Literature:
 - a. Complete design and construction data for dielectric unions and flanges.
 - b. Manufacturer's data on piping and fittings used, with an indication of each specific application.
 - 2. Performance Data:
 - a. 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. UL approval number, installation materials, and procedures for pipe penetrations of fire-rated walls and floor.

1.5 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 0500.
- 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.
- 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 Architect. 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 job site 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.

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.
 - 1. Manufacturer and Model:
 - a. Fernco: Lowflex Series 2000 for 4 inch or smaller; Series 1000 with stainless steel shear rings for up to 10 inches.

2.2 STEEL PIPING

- A. Pipe: Black steel pipe shall be seamless or electric resistance weld for pipe sizes 2 inch and above, conforming to ASTM A 54 Grade A below 2 inch, continuous weld conforming to ASTM A 53-89a Type B, ASTM A 106 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. 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 and weight as pipe used, except provide schedule 80 nipples when length of unthreaded part of nipple is less than 1-1/2 inch. 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 black steel bolts and nuts; galvanized steel flanges shall have galvanized steel bolts and nuts.

2.4 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 in 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 and architectural 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 or 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, if allowed by the local authority, 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. Insulated Piping: Pipe requiring insulation shall be installed with sufficient clearances to permit proper application of insulation.
- F. 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.
- G. 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.
- H. 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 nipple with hose end and cap.
- I. Tool Marks: Copper, brass and chromed, polished or painted piping, fittings and connections fixtures shall not show tool marks. Replace damaged piping and fittings.
- J. 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/or 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, rigid support, sway bracing as indicated or as required to eliminate excessive piping movement in thermal and pressure piping systems including after work completion.

3.3 JOINTS AND CONNECTIONS

- A. General: Align all pipe before joints are made. Joints and connections shall be air, gas and watertight.
- 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 Architect may at his own discretion visually spot check welding work anytime. The Architect may also employ an outside testing agency to analyze, using whatever means available, any of the welded joints for imperfections. All welded joints found by inspection or testing to have imperfections shall be repaired as directed by the Architect.
- 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. Flanges: Connect pipe flanges to pipe ends in accordance with ASME B31.1. 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.
- G. 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.
- H. Rated Penetrations: Provide UL-approved method of sealing fire- and fire/smoke rated wall and floor penetrations. Submit method proposed prior to installation.

3.4 EQUIPMENT CONNECTIONS

- A. General: Make connections between equipment and piping system in this section of the specifications 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 inch.
- 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 pumps, steam traps and other 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.
- C. Pump Connections: Where the suction or discharge of any pump unit is smaller than the pipe size noted on the drawings, reducing elbows or fittings shall be provided at the pump connections only.
- D. Coil Connections: Where coil piping connections are smaller than the distribution piping size shown on the drawings, the reduction in size shall be provided as close to the coil as possible. All valves, strainers, unions, flanges, balancing valves, etc. shall be full distribution pipe size except for control valves.

3.5 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 steam and water piping to prevent air or water pockets occurring due to a change in pipe size. Eccentric couplings on steam shall bring the pipes flush on the bottom; eccentric couplings on water lines shall bring the pipes flush on top except as otherwise specified or indicated. Concentric reducing couplings in horizontal water circulating piping may be utilized if a manual air vent on the larger pipe adjacent to the reducer is installed.

3.6 PROTECTION

- A. Protective Wrap: Wrap pipe that touches metal or is exposed to masonry with a layer of 6 mil polyethylene film or 15 lb. felt.

- B. Thread Protection: Coat all exposed threads on galvanized steel pipe after assembly with two coats of zinc chromate. Remove pipe thread lubricants prior to applying paint.

3.7 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.
- 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 after cleaning.
- C. Chemical cleaning: After the piping is installed, add an aqueous solution of trisodium phosphate in a proportion of one pound per fifty gallons of water in the system. After filling with this solution, the system shall be allowed to circulate for two hours. The system shall then be drained completely. All strainers shall be removed, cleaned and replaced, and the system shall be refilled with fresh water. The Architect shall be given notice of this cleaning operation. If, in the opinion of the Architect, the cleaning operation has not been properly performed, the above procedure shall be repeated. After cleaning system, it shall be tested by litmus paper and shall be left on the slightly alkaline side (pH > 7.5). If the system is still acidic, the trisodium phosphate cleaning shall be repeated.

3.8 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 22 21 14

SECTION 22 34 05 – DOMESTIC WATER HEATERS, COMMERCIAL ELECTRIC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Special Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. Furnish and install water heater including all valves, fittings, overflow drain pan, relief valve, heat trap and appurtenances.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 22 and to all other applicable portions of the Drawings and Specifications.

1.4 SUBMITTALS

- A. Submit manufacturer's data for review before any work is commenced.

1.5 MANUFACTURERS

- A. Products listed in this Section or on the plans are based on a specific manufacturer to establish the desired style, quality and type. Equivalent products, complying with the requirements of this Section and the installation requirements of the plans, by the following manufacturers are acceptable:
 - 1. Lochinvar
 - 2. State Industries
 - 3. A. O. Smith

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Water heater shall be of size, voltage and wattage as shown on drawings. Tank shall be 300 p.s.i. test pressure, 150 p.s.i. W.P. approved; glass lined, with 1.315 dia. "Dow" magnesium tank saver. Elements will be copper sheath, tin coated immersion type, low watt density (75 watts p.s.i. maximum). Tank shall be insulated to ASHRAE 90A-1980 energy efficiency standards. Heater jacket shall be heavy gauge steel with baked enamel finish. Internal wiring

shall be composed of solid copper wire having an insulation material rated at 600 V, 200 C. Heater shall have a factory installed temperature and pressure relief valve.

B. Control Circuit:

1. Surface Mounted Thermostats: Individual thermostats with built-in manual reset hi limit providing staged control and over-temperature protection for each heating element.
2. Immersion Thermostats: Supplied with one magnetic contactor for each 18 KW increment. 120 volt control circuit with built in transformer.

C. Water heater shall be U.L. listed and approved and shall be fused in accordance with U.L. requirements.

D. Water heater to be size voltage and wattage as shown on drawings. Heater to be completely insulated and jacketed for (vertical) or (horizontal) installation. The jacket shall be rectangular 16-gauge galvanized steel with beige acrylic enamel finish. Jacket shall have a full-length hinged access door with key lock. Tank insulation shall be high-density fiberglass sufficient to meet ASHRAE 90A-1980 standards of 4 watts per square foot of tank surface maximum energy loss. Key lock door provides additional safety and security.

E. Tank construction shall be 300-pound test. 125-pound working pressure and be ASME stamped and National Board listed. All tanks are to be lined with vitreous glass, fired at 1600 provided molecular interchange of glass and steel. Manhole cleanout shall be standard on 500 through 2500 gallon models.

F. Handhole cleanout on heaters under 500 gallons heater shall include the following standard features: internal fusing for control and load circuits, built-in safety drain pan with piping connections, low-watt density incoloy sheath elements, ASME rated temperature and pressure relief valve, terminal block wiring, 180°F water temperature approval, U.L. listing, 3 year limited warranty.

G. Control system: Individual thermostats with built in manual reset hi limit providing staged control and hi-limit safety for each heating element. (Not available on horizontal models) - OR-

H. Water heater to be provided with fully adjustable temperature controls and automatic high limit control.

I. Magnetic contactors with immersion thermostat: 120 volt control with built in transformer.

J. The discharge from the relief valve shall be piped full-size separately to the outside of the building or to another approved terminal as provided for safety pan drain terminals but in no case shall the discharge from a relief valve be trapped.

K. Provide magnesium storage tank savers.

PART 3 - EXECUTION

3.1 GENERAL

- A. Provide gate valves on both the incoming cold water and leaving hot water supply piping.
- B. Cold water supply shall also be equipped with a check valve downstream of the gate valve.
- C. Provide unions to facilitate replacement of the storage tank and/or heater.

- D. Provide thermometer on the hot water discharge side piping of the water heater.
- E. Heat trap shall be installed in the hot water supply piping.

END OF SECTION 22 34 05

SECTION 22 40 00 – PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.
- B. Related Sections:
 - 1. Separate grab bars and toilet accessories not an integral part of plumbing fixtures are specified in Division-10.
- C. This Section specifies plumbing fixtures and trim. The types of fixtures specified included the following:
 - 1. Lavatories (including wheelchair type);
 - 2. Water Closets;
 - 3. Urinals;
 - 4. Faucets;
 - 5. Flush Valves;
 - 6. Toilet Seats;
 - 7. Sinks;
 - 8. Service Sinks;
 - 9. Fixture Supports (including wheelchair type);
 - 10. Wall Hydrants and Hose Bibbs;

1.2 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. ANSI Standard A17.1: "Specifications for Making Buildings and Facilities Accessible To and Usable By Physically Handicapped People."
 - 2. Public Law 90-480: "Architectural Barriers Act of 1968."
- B. Delivery, Storage, and Handling:
 - 1. Store fixtures where environmental conditions are uniformly maintained within the manufacturer's recommended temperatures to prevent damage.
 - 2. Store fixtures and trim in the manufacturer's original shipping containers. Do not stack containers or store in such a manner that may cause damage to the fixture or trim.
- C. Sequence and Scheduling:
 - 1. Schedule rough-in installations with the installation of other building components.

1.3 MAINTENANCE

- A. Extra Stock:
 - 1. Furnish special wrenches and other devices necessary for servicing plumbing fixtures and trim to Owner with receipt in a quantity of one device for each 10 fixtures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer uniformity shall be as specified in Section 220500: Basic Plumbing Requirements under

Product Options. Refer to plumbing fixture schedule and plans for additional information.

1. Subject to compliance with specified requirements, provide plumbing fixtures of one of the following:
 - a. Lavatories:
 - (a) Refer to architectural plans for countertop details or additional information.
 - b. Water Closets:
 - (a) Kohler Co.: K-4323, 1.6 gpf.
 - c. Urinals:
 - (a) Toto: UT104EV, 0.5 gpf.
 - d. Faucets:
 - (a) Kohler Co.: K-13463, 0.5 gpm, less temperature mixer.
 - e. Flush Valves:
 - (a) Water Closets: Zurn Industries, Inc.; Hydromechanics Div.: ZEMS6152AV, 1.6 gpf w/ manual push button override and 6VDC plug-in power converter. Refer to schedule for additional information.
 - (b) Urinals: Zurn Industries, Inc.; Hydromechanics Div.: ZEMS6195AV, 0.5 gpf w/ manual push button override and 6VDC plug-in power converter. Refer to schedule for additional information.
 - f. Water Closet Seats:
 - (a) Sperzel. (150-EEWSSCH)
 - (b) Bemis Mfg. Co
 - (c) Beneke Corp.
 - g. Service Sinks:
 - (a) Fiat products.
 - (b) Crane Co.
 - (c) Kohler Co.
 - h. Fixture Supports:
 - (a) Zurn Industries, Inc.; Hydromechanics Div. Z-1222, Z-1225, Z1231.
 - i. Wall Hydrants and Hose Bibbs:
 - (a) Woodford, B74, 3/4-inch male hose thread nozzle, vacuum breaker, hinged cover, loose key stem and door. (Interior).
 - (b) Woodford, B65, 3/4-inch male hose thread nozzle, vacuum breaker, hinged cover, loose key stem and door. (Exterior).
 - (c) Woodford, 24P-3/4 (mech rooms, plumbing chases).

2.2 FIXTURES (See schedule)

2.3 FIXTURE SUPPORTS (See schedule)

2.4 WALL HYDRANTS (See schedule)

2.5 ELECTRIC WATER HEATER (See schedule and spec section 223405)

2.6 FITTINGS, TRIM AND ACCESSORIES

- A. Toilet Seats: elongated, solid white heavy duty, extended closed back/open front, less cover, and having stainless steel check hinge and four replaceable bumpers.
- B. P-trap, supplies and stops: 17 GA.C.P.
 1. McGuire
 2. Brass Craft

2.7 ESCUTCHEONS

- A. Chrome-plated cast brass with set screw.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify all dimensions by field measurements. Verify that all plumbing fixtures may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.
- B. Examine rough-in for potable water and waste piping systems to verify actual locations of piping connections prior to installing fixtures.
- C. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.
- D. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install plumbing fixtures level and plumb, in accordance with fixture manufacturer's written instructions, rough-in drawings, and pertinent codes and regulations, the original design, and the referenced standards.
- B. Comply with the installation requirements of ANSI A111.1 and Public Law 90-480 with respect to plumbing fixtures for the physically handicapped.
- C. Fasten plumbing fixtures securely to supports or building structure. Secure supplies behind or within wall construction to provide rigid installation.
- D. Set mop basins in a leveling bed of cement grout. Provide continuous sealant at perimeter.
- E. Install a stop valve in an accessible location in the water connection to each fixture.
- F. Install escutcheons at each wall, floor, and ceiling penetration in exposed finished locations and within cabinets and millwork.
- G. Seal fixtures to walls and floors using silicone sealant as specified in Section 079200. Match sealant color to fixture color.

3.3 FIELD QUALITY CONTROL

- A. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning units, then retest.
- B. Inspect each installed unit for damage. Replace damaged fixtures.

3.4 ADJUSTING

- A. Adjust water pressure at faucets and flush valves to provide proper flow and stream.
- B. Replace washers of leaking or dripping faucets and stops. Clean fixtures, trim, and strainers using manufacturer's recommended cleaning methods and materials.

3.5 CLEANING

- A. Clean fixtures, trim, and strainers using manufacturer's recommended cleaning methods and materials.

3.6 PROTECTION

- A. Provide protective covering for installed fixtures and trim.
- B. Do not allow use of fixtures for temporary facilities unless expressly approved in writing by the Owner.

3.7 ROUGH-IN SCHEDULE (Refer to Drawings)

3.8 MOUNTING HEIGHTS SCHEDULE

<u>Fixture</u>	<u>Mounting Height</u>
Water Closet	15" floor to rim
Wheelchair Water Closet	18" floor to rim
Standard Urinals	22" floor to rim
Accessible Urinals	17" floor to rim

END OF SECTION 22 40 00

DIVISION 23

SECTION 23 01 00 - GENERAL MECHANICAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE OF DIVISION

- A. Work shall include all materials, equipment and labor necessary for a complete and properly functioning mechanical installation in accordance with all applicable codes, and contract drawings and specifications. Work shall include all work specified in Division-22, Plumbing and Division-23, HVAC.
- B. Pay for all required licenses, fees, inspections and permits.

1.3 RELATION TO OTHER WORK

- A. Work Not in Divisions 22 and 23: Related work not included in this division consists of requirements given in the following as may be included in the contract documents:
 - 1. Other divisions which may include work (such as concrete, steel, painting, ceiling systems, structure and other work) related to the work of Divisions 22 and 23.
- B. Work of Divisions 22 and 23: Any or all sections of Divisions 22 and 23 may include a paragraph or paragraphs under the heading, "Relation to other Work". Where such a paragraph is indicated and work directly related to the section is listed or described, such work shall be considered as relating directly to the indicated section. Any related work (directly related or otherwise) which may be omitted by reference from the "Relation to Other Work" paragraph of such section(s), shall be provided as necessary and required whether or not such work is included by reference. Such listing or description of related work within a section is given only as a convenience to the Contractor; omission of other related sections or described work does not in any way exclude the provision of such work.

1.4 CODES

- A. Install all work in accordance with the latest edition of all applicable regulations and governing codes, including the regulations of the utility companies serving the project.
- B. Where a conflict in code requirements occurs the more stringent requirement shall govern.

1.5 STANDARDS

- A. All equipment and devices shall bear U.L. label, the label of an industry recognized approved testing agency or A.G.A. certification for said item of equipment or device.
- B. All electrical devices must be U.L. Listed.
- C. NFPA: All materials and adhesives used shall conform to the requirements of NFPA 90A as to flame spread and smoke developed ratings.
- D. **LEED: All materials, adhesives, and sealants shall conform to the requirements of LEED as to low VOC content.**

1.6 LEED SUBMITTALS

- A. *Submit Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.*

1.7 DRAWINGS

- A. Architectural and structural drawings take precedence over mechanical drawings with reference to the building construction. Mechanical drawings are diagrammatic and indicate the general arrangement and extent of work. Architectural drawings indicate more exactly the desired relationship between diffusers, registers, lighting fixtures, equipment, electric panels and devices, plumbing fixtures, and other items which remain exposed in the completed building. Exact locations and arrangement of materials and equipment shall be determined, with the acceptance of the Architect/Engineer, as work progresses to conform in the best possible manner with the surroundings and with the adjoining work of other trades. Where locations of equipment, devices or fixtures are controlled by architectural features, establish such locations by referring to dimensions on Architectural drawings and not by scaling drawings.

1.8 DISCREPANCIES

- A. In case of differences between drawings and specifications, or where drawings and specifications are not clear or definite, the subject shall be referred to Architect/Engineer for clarification and instructions.

1.9 ELECTRICAL PROVISIONS

- A. Work of Divisions 22 and 23 shall include the electrical requirements which are indicated to be integral with mechanical work and which can be summarized to include (but not necessarily be limited to) the following:
1. Motors.
 2. Motor starters.
 3. Wiring from mechanical equipment to electrical work termination (junction box or disconnect switch).
 4. Control switch, pilot lights, interlocks and similar devices.
 5. Electrical heating coils and similar elements in mechanical equipment.
 6. Electrical work specified in Division-23 for the HVAC control system.
 7. Drip pans to protect electrical work.
- B. Motors, Starters, Switches: Provide with all motorized mechanical equipment unless otherwise indicated.
- C. Drip Pans: Where possible, do not run mechanical piping directly above electrical (or electronic) equipment which is sensitive to moisture; otherwise provide drip pans under mechanical piping. Locate pan below piping, and extend 6" on each side of piping and lengthwise 18" beyond equipment. Fabricate pans 2" deep, of reinforced sheet metal with rolled edges and soldered or welded seams; 20 gage copper, or 16 gage steel with 2 oz. zinc finish hot dipped after fabrication. Provide 3/4" copper drainage piping, properly discharged.

- D. Motors: Unless specifically specified otherwise in the section covering the driven equipment (or the equipment drives), motors shall comply with the following:
1. Three Phase: NEMA design B, three-phase, squirrel cage induction type designed for 1800 rpm synchronous speed for operation in 40°C ambient at 1.15 service factor at constant speed on the scheduled voltage. Motors shall be insulated with Class B insulation material and shall be cast iron, drip proof, horizontal foot mounted type with ball bearings. Two speed motors shall be provided as scheduled and shall be two winding type.
 2. Single Phase: Squirrel cage induction type designed for 1800 rpm synchronous speed for operation in 40°C ambient at 1.15 service factor at constant speed on the scheduled voltage. Motors shall be insulated with Class B insulation materials and shall be two winding capacitor start type with steel enclosure, drip proof, horizontal foot mount and ball bearings.
 3. Electric motors which are designated to be high efficiency type shall also comply with the section describing high efficiency motors.
 4. Provide shaft grounding kits for all motors to be driven by a variable frequency drives.
- E. Scheduled Horsepower: 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, these horsepower are non-overloading and may also include provisions for future planned impeller changes. If the actual horsepower for the equipment furnished differs from that specified or shown on the drawings, it shall be the Contractor's responsibility to insure that proper size feeders, breakers, starters, etc. are provided at no change in contract price.
- F. Any TEFC motors shall have Class F insulation.
- G. Drip proof protected motors shall have Class B insulation.
- H. Manufacturer: Electric motors, complying with the requirements of this Section and the installation and performance requirements of the plans, by the following manufacturers are acceptable:
1. Reliance Electric
 2. Baldor
 3. General Electric
 4. Westinghouse

1.10 ELECTRICAL/MECHANICAL WORK

- A. Definitions: Definitions for the purpose of mechanical/electrical control and power coordination are as follows: (Note: The use of the words, "Provide", "furnish" and "install" are intended only for use in describing the coordination indicated by this paragraph and do not necessarily have the same definitions when used outside of the context of this paragraph.) Any items which do not fall within the scope of this paragraph shall be coordinated as individually specified.
1. "Furnish" means to procure an item and to deliver it to the project for installation.
 2. "Install" means to determine (in coordination with others as necessary) the appropriate intended location of an item and to set and connect it in place.
 3. "Provide" means to both furnish and install.
 4. Power Circuit: Circuit which carries main electric power to apparatus to which the power circuit is connected.

5. Control Circuit: Circuit which carries electrical signals directing the performance of a controller but which does not carry the main electric power. (See NEC, Section 430-71.) Such circuits shall also include those which serve a dual control and power function (e.g., a line voltage thermostat circuit which both activates and powers a small fan motor).
 6. Controller: A device, or group of devices, which serves to govern, in some predetermined manner, electric power delivered to apparatus to which the controller is connected and includes any switch or device normally used to start and stop a motor. (See NEC, Article 100, Definitions, "Controller", and Section 430-81(a).)
 7. Control Device: A device which reacts to an operating condition (pressure, temperature, flow, humidity, etc.) and which initiates transmission of an electrical control signal which causes operation of a controller or which causes operation of pressure switches, etc.
 8. Auxiliary Control Device: A device (such as a low voltage control transformer, electric relay, etc.) which is located in a control circuit and which carries or responds to (but does not initiate) an electrical control signal initiated by a control device.
- B. Work of Division-23 includes (but is not necessarily limited to):
1. Provide:
 - a. All controllers which are generally manufactured or shipped as integral with Division-23 equipment (such as starters packaged with air cooled chillers, etc.).
 - b. All electric motors and other electrical power consuming equipment (such as electric air heating coils, electric boilers, electric hot water heaters, etc.) which are specified in Division 22 or 23.
 - c. All control circuits (including conduit and boxes) from the Division-26 panels to point of use including the necessary circuit breakers.
 - d. All other control circuits, including conduit and boxes.
 - e. All control connections to equipment.
 - f. All control connections to controllers, switches, motors and other mechanical systems electrical power consuming equipment (such as electric air heating coils, electric boilers, electric hot water heaters, etc.).
 - g. Auxiliary control devices.
 - h. All control devices (thermostats, pressure switches, flow switches, humidistats, etc.) and make control circuit connections thereto.
 - i. Any and all pneumatic and electronic and electric control devices and electric or pneumatic connections thereto.
 2. Furnish:
 - a. All controllers which are generally manufactured and/or shipped as separate but companion items to Division-23 equipment (such as centrifugal chiller starters which are matched with the chillers but are not physically an integral part of the chiller assembly.)
- C. Work of Division-26 includes (but is not necessarily limited to):

1. Provide:

- a. All power circuits, including conduit and boxes.
- b. All power connections to controllers, switches, motors and other mechanical systems electrical power consuming equipment (such as electric air heating coils, electric boilers, electric hot water heaters, etc.).
- c. All remote motor disconnects (remote from the related controller) at all locations required by NEC and connections thereto except those disconnects which are specified in Division-23 to be provided as part of the equipment itself.
- d. All controllers (except those which are generally manufactured or shipped as separate but companion items to Division-23 equipment such as centrifugal chiller starters).

2. Install:

- a. All controllers which are generally manufactured and/or shipped as separate but companion items to Division-23 equipment (e.g., chiller starters).

1.11 AUXILIARIES AND ACCESSORIES

- A. Include all auxiliaries and accessories for complete and properly operating systems.

1.12 INVESTIGATION OF SITE

- A. Check site and existing conditions thoroughly before bidding. Advise Architect/Engineer of discrepancies or questions noted before bidding.

1.13 ASBESTOS

- A. Should asbestos, or any other hazardous waste material, be encountered during the execution of the work, or should the presence of asbestos or any other hazardous material be suspected, immediately notify the Owner and suspend all work in the affected area. The Owner will activate an assessment study to determine the presence of asbestos, or other hazardous material, and evaluate what condition it is in. Removal of asbestos, or other hazardous material, if required, will be conducted by a qualified Contractor, and will be done under separate contract.

1.14 COORDINATION

- A. Provide all required coordination and supervision where work of this division connects to or is affected by work of others.

1.15 PROVISIONS FOR OPENINGS

- A. Provide all openings required for work performed under Division-23. Provide sleeves or other approved methods to allow passage of items installed under any Section of Division-23.

1.16 INTERRUPTION OF EXISTING SERVICES

- A. Any interruption of existing services shall be coordinated in advance with the Owner's Representative. Shutdown time and duration of critical services shall be decided by the Owner. Contractor shall provide shutoff valves at point of tie-in to minimize downtime.

1.17 CLEANING AND PROTECTION

- A. Ductwork: Keep the interior of the duct system free from dirt and rubbish and other foreign matter. All fan motors, switches, and other items, shall also be protected from dirt, rubbish and other foreign matter during building construction. Thoroughly clean all components of the ductwork and remove all dirt, scale, oil and other foreign substances which may have accumulated during the installation process.
- B. Equipment: All mechanical equipment provided shall be thoroughly cleaned of all dirt, oil, concrete, etc. Any dents, scratches or other visible blemishes shall be corrected and the appearance of the equipment made "like new" and to the satisfaction of the Architect/Engineer.
- C. Upon completion, and before final acceptance of the work, all debris, rubbish, leftover materials, tools and equipment shall be removed from the site.
- D. Protection of Work Until Final Acceptance: Protect all materials and equipment from damage, entrance of dirt and construction debris from the time of installation until final acceptance. Any materials and equipment which are damaged shall be repaired to "as new" condition or replaced at the direction of the Architect/Engineer. Where factory finishes occur and damage is minor, finishes may be touched up. If, in the opinion of the Architect/Engineer the damage is excessive, factory finish shall be replaced to "new" condition.

1.18 SHOP DRAWINGS

- A. Submit shop drawings for all items, services and systems included in the project.
- B. Shop drawings shall clearly show the following:
 - 1. Technical and descriptive data in detail equal to or greater than the data given in the item specification. Indicate all characteristics, special modifications and features. Where performance and characteristic data is shown on the drawings or specified, submitted data shall be provided in a degree which is both quantitatively and qualitatively equal to that specified and shown so that comparison can be made. Present data in detail equal to or greater than that given in item specification and include all weights, deflections, speeds, velocities, pressure drops, operating temperatures, operating curves, temperature ranges, sound ratings, dimensions, sizes, manufacturers' names, model numbers, types of material used, operating pressures, full load amperages, starting amperages, fouling factors, capacities, set points, chemical compositions, certifications and endorsements, operating voltages, thicknesses, gauges and all other related information as applicable to particular item.
 - 2. Exceptions to or deviations from the contract documents. Should Architect/Engineer accept any items having such deviations which are not clearly brought to Architect/Engineer's attention, in writing, on item submittal, then Contractor is responsible for correction of such deviations regardless of when such deviations are discovered.
- C. Additional Requirements: See specific sections of the Specifications for any additional requirements.

1.19 SHOP DRAWINGS TECHNICAL INFORMATION BROCHURE

- A. Submit within thirty days after Notice to Proceed. Each brochure shall consist of an adequately sized, hard-cover, 3-ring binder for 8-1/2" x 11" sheets. Provide correct designation on outside cover and on spine of binder, i.e., mechanical. All shop drawings shall be submitted at one time; partial submittals will not be accepted.

- B. First sheet in the brochure shall be a photocopy of the "Division-23 Index" for these specifications. Second sheet shall be prepared by the Contractor and shall list Project addresses for this Project for Contractor and all major subcontractors and suppliers.
- C. Provide reinforced separation sheets tabbed with the appropriate specifications section reference number and typed index for each section.
- D. Shop drawing technical and descriptive data shall be inserted in the brochure in proper order on all items. Mark the appropriate specification section or drawing reference number in the right hand corner of each item. Provide complete information, including, but not limited to, wiring and control diagrams, scale drawings showing that proposed substitute equipment will fit into allotted space (indicate all service access, connections, etc.), test data, and other data required to determine if equipment complies fully with the specifications. All typewritten pages shall be on contractor or equipment manufacturer printed letterhead.
- E. At the end of the brochure, provide and insert a copy of the specifications for Division-23 and all addenda applicable to this Division.
- F. Submit not less than six brochures. Provide separate tag marking on an individual copy for the Owner, Architect, Engineer, Contractor, Subcontractor (two copies).
- G. Contractor shall review the brochure before submitting. Submittal information on each item in each brochure shall bear the Contractor's stamp of approval, initials of checker and date checked by him. No request for payment of or substitutions will be considered until brochure has been reviewed by the Contractor and submitted for checking.

1.20 SHOP DRAWINGS FOR PIPING SYSTEMS AND DUCT SYSTEMS

- A. Shop drawings for piping systems and duct systems shall be of sufficient scale to verify clearances and equipment locations. Shop drawings shall show all required maintenance and operational clearances required. Cost of shop drawing preparation and reproduction shall be borne by the Contractor. Title drawings shall include identification of project and names of Architect, Engineer, Contractor, subcontractor and/or supplier, date, be numbered sequentially and shall indicate the following:
 - 1. Architectural and structural (as required) backgrounds with room names and numbers, etc., including but not limited to plans, sections, elevations, details, etc.
 - a. Fabrication and Erection dimensions.
 - b. Arrangements and sectional views.
 - c. Necessary details, including complete information for making connections with other work.
 - d. Kinds of materials and finishes.
 - e. Descriptive names of equipment.
 - f. Modifications and options to standard equipment required by the contract.
- B. In order to facilitate review of drawings, insofar as practicable, they shall be noted, indicating by cross reference the contract drawings, note, and/or specification paragraph numbers where item(s) occur in the contract documents.
- C. Also provide shop drawings, of the architectural reflected ceiling plans, which indicate locations of the following (to be verified by Contractor): Air distribution devices, sprinkler heads, lights and access panels.

D. See specific sections of specifications for further requirements.

1.21 AIR HANDLING UNIT AND DUCTWORK CONFIGURATION SHOP DRAWINGS

- A. Contractor shall submit a shop drawing for each air handling unit. Such shop drawings shall meet the following requirements:
1. Be drawn at not less than a scale of $1/4" = 1'-0"$. Contractor may elect to use a larger scale if he desires (i.e., if drawing of unit is at $1/4" = 1'-0"$, $1/2" = 1'-0"$ may be used.).
 2. Clearly show all proposed ductwork configuration changes (sizes, routing, and similar differences) which are different in any respect from the Drawings. Extent of shop drawings shall show all ductwork to and from each unit beginning with and terminating at those points where ductwork is intended to remain unchanged as shown on Drawings.
 3. Where proposed changes affect any other work such as structure, housekeeping pads, piping, equipment, electrical work or any other work, shop drawings shall clearly show those proposed changes.
 4. Proposed changes shall be at no additional change in contract price.
 5. Where Drawings show units in plan only, shop drawings shall show proposed units in plan and also in elevation.
 6. Shop drawings shall also show exact locations of related work (such as bar joists, columns, beams, sound attenuators, and like items) which affect the proposed ductwork routing and unit location and configuration.
 7. Each section of each air handling unit shall be clearly identified (i.e., coil section, fan section, filter section, mixing box section, etc.).
- B. Failure to submit these shop drawings together at the same time with the air handling unit shop drawings will result in total disapproval of the proposed air handling units. Time delays or other reasons will not be considered.

1.22 COORDINATION DRAWINGS

- A. In addition to shop drawings and prior to commencement of installation, prepare coordination drawings for work under this division, as specified in Division 01, in full cooperation with persons performing work under other Divisions, including but not limited to mechanical, electrical, plumbing, fire protection, telecommunications, audio/visual and miscellaneous steel.
- B. Drawings shall not be formally submitted but shall be kept on site for reference. Notify Architect and CM of conflicts that cannot be resolved.
1. Drawn to a scale of $1/4" = 1'-0"$.
 2. Room dimensions.
 3. Sheet size matching contract documents.
 4. Duct sizes with bottom elevation from finished floor.
 5. Show equipment, columns, and beams.
 6. Duct fitting details.
 7. Construction details of plenums and casings.
 8. Concrete pad and foundation layouts including anchor bolt and sleeve locations.
 9. Dimensioned floor drain locations.
 10. Wall mounted equipment.
 11. Piping 3" and larger, with elevations from finished floor to bottom of pipe.

- 12. Space allocation for conduits and cable trays.
- 13. Ceiling height

1.23 ELECTRONIC FILES

- A. CADD files will be available on a limited basis to qualified firms at the Architects prerogative. The cost of the files will be \$100 per sheet. Recipients are cautioned that these files may not accurately show actual conditions as constructed. Users are responsible to verify actual field conditions. These files are not intended to be used as shop drawings.
 - 1. A request for CADD files should be delivered in writing along with payment for such files. Files will not be processed until payment is received.

1.24 OPERATING INSTRUCTIONS

- A. Submit for checking a specific set of written operating instructions on each item which requires instructions to operate. After acceptance, insert information in each Technical Information Brochure. Refer also to other sections which may describe operating instructions.

1.25 MAINTENANCE INFORMATION

- A. Submit for acceptance Maintenance Information consisting of manufacturer's printed instruction and parts lists for each major item of equipment. After acceptance, insert information in each Technical Information Brochure. Refer also to other sections which may describe maintenance.

1.26 MANUFACTURER'S CHECK-OUT

- A. Check out by Manufacturer's Representative (for major items of equipment): At completion of construction and after performance verification information as above-mentioned has been gathered, submitted and accepted, provide one copy of this information to the manufacturer's representative. Work required under this section shall include having the representative examine the performance verification information, check the equipment in the field while it is operating, and sign a Check-Out Memo for record. Submit a copy of the memo on each major item of equipment for each brochure. Accepted memos shall be inserted on each brochure with the performance verification information and submittal data. Memos shall be submitted and accepted before Instruction in Operation to Owner or a request for final inspection.

1.27 SYSTEM GUARANTEE

- A. The work required under Division-23 shall include a one year guarantee. This guarantee shall be by the Contractor to the Owner to replace for the Owner any defective workmanship, equipment, or material which has been furnished under this Contract at no cost to the Owner for a period of one year from the date of acceptance of the System. This guarantee shall also include reasonable adjustments of the system required for proper operation during the guarantee period. Explain the provisions of guarantee to Owner at the "Instruction in Operation Conference".

1.28 INSTRUCTION TO OWNER

- A. Submit all required items for checking one week before final inspection of the building is scheduled. When all items are accepted and placed in the proper brochures, the Contractor shall give notice in writing that he is ready to give the Owner an "Instruction in Operation Conference". After the above mentioned request is received the Contractor will be notified of the time the conference can be held with the Owner. At the conference, the Contractor shall review with the Owner all appropriate information. At the end of the conference, seven copies of a memo certifying Instruction in Operation

and Completed Demonstration shall be signed by the Contractor, Subcontractor and Owner and one copy inserted in each brochure.

1.29 MATERIALS AND EQUIPMENT

- A. Each bidder represents that his bid is based upon the materials and equipment described in this division of the specifications.
 - 1. Submittal shall include the name of the material or equipment for which it is to be substituted, substituted equipment model numbers, drawings, cuts, performance and test data and any other data or information necessary for the Architect/Engineer to determine that the equipment meets all specification and requirements. If the Architect/Engineer accepts any proposed substitutions, such acceptance will be set forth in writing.
 - 2. Substituted equipment with all accessories installed or optional equipment where permitted and accepted, must conform to space requirements. Any substituted equipment that cannot meet space requirements, whether accepted or not, shall be replaced at the Contractor's expense. Any modifications of related systems of this or other trades as a result of substitutions shall be made at the Contractor's expense, and Contractor shall so state in his written request for substitution.

1.30 ACCEPTABLE MANUFACTURERS

- A. Acceptable Manufacturers: Materials and Equipment specified in these contract documents are accepted only in regards to general performance and quality. It shall be the Contractor's responsibility to insure that acceptable materials and equipment meet or exceed the efficiencies, capacities, electrical characteristics, performance and quality of the equipment herein specified. Acceptable equipment must also generally conform, without extensive modification of related systems to the accessories, weights, space and maintenance requirements, etc., of the specified equipment. Any modification to related systems of this or other trades shall be made at the Contractor's expense and the Contractor shall be responsible for coordination between trades. Any difference in capacity, efficiency, electrical characteristics, weights or quality of product, etc., between specified materials and equipment and acceptable alternates shall be submitted to the Architect/Engineer for acceptance within 30 days of Notice to Proceed.

PART 2 - PRODUCTS

- 2.1 Section part not applicable.

PART 3 - EXECUTION

- 3.1 Section part not applicable.

END OF SECTION 23 01 00

SECTION 23 05 00 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section, in addition to the following:

1.2 SCOPE

- A. Materials listed herein are general mechanical materials to be used under the Division 22 and 23 sections of the specifications unless specifically noted otherwise in the particular section or on the drawings.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 22 and 23 and to all other applicable portions of the Drawings and Specifications. This section relates to all sections of Division 23 as may be applicable to the work of each section.

1.4 STANDARDS

- A. Quality and weight of materials shall comply with requirements and specifications of the appropriate standards of the American Society of Testing and Materials.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT, GENERAL

- A. All materials and equipment shall be new and without blemish or defect.
- B. Equipment and materials shall be products which will meet with the acceptance of the agency inspecting the work. Where acceptance is contingent upon having the products examined, tested and certified by Underwriters Laboratory or other recognized testing laboratory, the product shall be so examined, tested and certified.
- C. Where no specific indication as to the type or quality of material or equipment is indicated, a standard item or system shall be furnished with all options, features and capabilities to meet the project requirements.
- D. Performance and Capacity:
 - 1. Performance as delineated in schedules and in the specifications shall be interpreted as minimum performance. In some cases equipment may be sized to allow for future requirements or for other reasons which may not be stated on the Drawings or in the Specifications; provide equipment and systems with the capacities, capabilities and features indicated to provide the maximum or minimum (as appropriate) conditions.
- E. Operating conditions and capacities must be as follows:
 - 1. No overloading.

2. No operation at conditions outside of maximum and minimum limits recommended by the manufacturer and accepted by the Architect/Engineer.
 3. Compatible with all systems.
- F. Unless otherwise specified, all equipment and materials furnished must be as follows:
1. Recommended by the manufacturer for the application.
 2. Installed in accordance with the manufacturer's recommendations for the application except where specifications and drawings clearly indicate otherwise.

2.2 ACCESS DOORS AND PANELS

- A. Coordination with architectural drawings and specifications: Access doors and panels specified in architectural drawings and/or specifications take precedence over specified items below.
- B. Locations: Provide access doors and panels (access units) as necessary for access to items which are concealed and which may require service maintenance, inspection, repair, removal or other reason for accessibility. Examples of such items include, but are not limited to, the following: valves, cleanouts, pipe unions, expansion joints and connectors, dampers, coils, junction boxes, duct heaters, terminal units, HVAC control system devices and similar types of items.
- C. Access units: Shall be manufactured by the Milcor Division of Inland-Ryerson, Boico, Nystrom or Ventfabrics. Types are as follows (Milcor style designations are used for example only):

<u>Location</u>	<u>Door/Panel Type</u>
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)	

- D. 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°F maximum".
 2. Have an automatic closing device and mechanism to release the latch bolt from the inside.
 3. Acceptable Manufacturers: Boico Style F, Inryco/Milcor Style VA, Nystrom Style APFR.
- E. Non-fire Rated Units:
1. Steel panels and frames.
 2. Locks and latches shall be as 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.
- F. 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.

G. Sizes:

1. Minimum size: 8" x 8".
2. Sizes of each unit shall be individually selected to allow the recommended and required service and maintenance and accessibility functions to be accomplished. These functions shall generally include, for example, valve removal, damper linkage resetting, control adjustment, lubrication, repair, replacement and similar tasks as may be necessary and recommended for the concealed item.
3. Sizes shall be of the following increments (unless otherwise approved) to allow the accessibility function to be accomplished: 8" x 8", 8" x 12", 12" x 12", 12" x 16", 16" x 16", 16" x 24", 24" x 24", 24" x 36", 30" x 30", 36" x 36" or 36" x 48".
4. No size smaller than 16" x 24" shall be allowed when a person must pass through the access opening in order to accomplish the desired accessibility function.
5. Every attic or furred space in which mechanical equipment is installed shall be accessible by an opening and passageway as large as the largest piece of the equipment and in no case less than 22 x 36 inches continuous from the opening to the equipment and its controls. The opening to the passageway shall be located not more than 20 feet from the equipment measured along the center line of such passageway.

2.3 PAINTING AND MARKING

- A. All paint and materials used for painting shall be manufacturer's "first quality" product. For additional paint material requirements, refer to Section 099101, Painting.
- B. Marking: Refer also to sections describing identification of mechanical systems.

2.4 PIPE HANGERS AND SUPPORTING DEVICES

- A. General: Refer to other sections of Division 23 for any requirements which may be additional to this section. Comply with the more stringent requirement if more than one method is specified or shown.
- B. Pipe supporting devices specified herein shall apply to all Division 22 and 23 piping unless modified in subsequent sections of Division 22 and 23 (ie., vibration isolation) or detailed on the drawings.
 1. Pipe hangers for copper pipe shall be copper or copperplated and for steel pipe shall be zinc-plated, clevis type hangers.
 2. Hangers for pressure piping shall be clevis type or accepted as equivalent. Pipe hangers shall be capable of vertical adjustment after erection of the piping. Piping shall not be hung from fire and/or smoke walls.
 3. Vertical piping supports shall be constructed of carbon steel with rounded ears and two or four holes for clamping bolts. Steel, galvanized and cast iron piping riser clamps shall have galvanized finish. Copper and brass piping riser clamps shall have electro-plated copper or PVC coating finish.
 4. Acceptable Manufacturers are Grinnell, PHD Manufacturing Inc., Fee and Mason, Michigan and Elcen.

- C. Beam clamps may be used when supporting piping from steel structures.
- D. Concrete inserts shall be placed in forms as work of Division 22 and 23 prior to the time that concrete is poured.
- E. Lead tamp-ins may be used when installed in a concrete or masonry wall or other like vertical surface to support a vertical hanger. Lead tamp-ins will not be permitted to support hangers to the underside of a concrete slab.
- F. For parallel runs of above ground suspended piping, an acceptable trapeze-type hanger may be used. Provide permanent, non-conductive type wrapping between copper pipe and steel trapeze hangers.
- G. Powder set type fasteners or inserts shall not be used.

2.5 FLOOR, WALL OR CEILING PLATES OR ESCUTCHEONS IN EXPOSED AREAS

- A. Shall be chrome-plated. Escutcheons for extended sleeves shall be of the type designed for that purpose. Split ring escutcheons will not be allowed.
- B. Escutcheons to be as manufactured by Guarantee Specialty Mfg. Co., Cleveland, Ohio; American Sanitary Mfg. Co., Abingdon, Ill., or Beaton Cadwell.
- C. 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 equivalent to Benton & Caldwell No. 3A chromium plated brass; for sleeves extending above floor shall be equivalent to Benton & Caldwell No. 36 chrome plated brass. Collars or plates for ducts and large diameter insulated pipe shall be fabricated of 18 gage galvanized copper bearing sheet steel, secured to structure and neatly fitted around duct or pipe.

2.6 SLEEVES

- A. General: Lay out work and set sleeves in new or existing construction so that minimum cutting, drilling and patching is required. Seal all sleeves not used during construction period with grout. Seal unused penetrations and sleeves through fire rated barriers to prevent passage of smoke and heat using an Underwriters' Laboratories approved method; sealing method must be rated at least equivalent to the barrier being penetrated. Submit proposed method to show proof of UL approval.
- B. Pipe Sleeves, Special Considerations: The following conditions require pipe sleeves as indicated:
 - 1. Where subject to hydrostatic pressure: Sleeves installed in walls and floors subject to hydrostatic (water) pressures shall be "Link Seal" (Thunderline Corp) Type WS or accepted as equivalent.
 - 2. Where piping is existing: When fire rated walls are to be erected where there is existing piping, provide Proset fire rated split wall system pipe sleeves, or accepted equivalent.
 - 3. Where penetration is part of air duct or plenum system: Do not use plastic pipe for sleeves where floor being penetrated is part of an air plenum so that no fire or smoke hazard is introduced by use of plastic.
 - 4. Where penetration is through fire rated barriers: Provide mild steel sleeves for penetrations of fire rated barriers.

C. Pipe Sleeves in Walls and Partitions:

1. Sleeves Above Grade: Use schedule 40 mild steel pipe or schedule 80 CPVC pipe. Provide sleeves built into wall, partition or beam of size to allow penetration by carrier pipe and insulation covering with not less than 1/4 inch minimum clear space between outer surface of carrier pipe covering (or carrier pipe surface if no covering is provided) and inner surface of sleeve.
2. Sleeves Below Grade in Exterior Walls: Schedule 40 steel hot dipped galvanized after fabrication or cast iron sleeve with not less than 1/4-inch x 3-inch center flange (water stop) around the exterior face of the wall.
3. Penetrations of fire rated barriers shall have only mild steel sleeves; plastic is not allowed.

D. Pipe Sleeves in Floors Above Grade: Use schedule 40 mild steel pipe or schedule 80 CPVC pipe. Provide sleeves built into wall, partition or beam of size to allow penetration by carrier pipe and insulation covering with not less than 1/4 inch minimum clear space between outer surface of carrier pipe covering (or carrier pipe surface if no covering is provided) and inner surface of sleeve. Set sleeves before floor is poured; extend not less than 1/2-inch above finished floor.

E. Pipe Sleeves in Floors on Grade: Sleeves shall be Schedule 40 steel or Schedule 80 CPVC plastic. Set sleeves before floor is poured. Size sleeves to allow penetration by carrier pipe and insulation covering with not less than 1/4 inch minimum clear space between outer surface of carrier pipe covering (or carrier pipe surface if no covering is provided) and inner surface of sleeve. Extend sleeve not less than 1/2 inch above finished floor.

F. Duct Sleeves: Sleeves or openings sized to pass mechanical ducts and covering shall be of framed steel construction in roof, wall, and partitions.

G. Sealing of Sleeves:

1. Pipe Sleeves Below Grade and On Grade: Caulk annular space between pipe and sleeve using approved caulking material to a minimum one inch deep. Result shall be a water tight and vermin proof penetration.
2. Pipe and Duct Sleeves Above Grade: Openings around pipes, ducts and other conduit passing through sleeves shall be made draft free and vermin-proof by solidly packing with mineral wool or fiberglass or by other such approved method.
3. Pipe and Duct Sleeves Through Fire Rated Barriers: All penetrations through fire rated barriers (both walls and floors) shall comply with Division-07 or be as specified in this Division.

2.7 FIRE/SMOKE RATED FLOOR, PARTITION OR WALL PENETRATION SEALANT

- A. Seal shall be composed of fire barrier product, putty, or caulking materials used either in combination or singularly. Acceptable Manufacturers are 3M Corporation or Dow Corning.

2.8 EXCAVATION AND BACKFILL

- A. Provide as necessary to accomplish work specified. Perform in accordance with applicable State and Local codes and accepted good practice and in accordance with other applicable sections or divisions.

2.9 BELT DRIVES

- A. General: Equip each motor driven machine not direct connected with 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.

The rating of each drive shall be as recommended by manufacturer for service but shall be at least 1.5 times nameplate rating of motor.

- B. Speed Adjustment: Adjust fan speed by change(s) in sheave size as necessary to obtain proper design air flow with fan in its installed location. Fans may be first fitted with variable pitch drives until proper speed adjustment is made and then fitted with proper fixed pitch drive size, or alternate sizes of fixed pitch drives may be used until proper fan needed to deliver necessary air quantity.
- C. Vibration of Air Handling Equipment and Fan Units: For air handling equipment and fans driven by motors 5-hp or greater, field vibration levels will not be acceptable if the maximum vibration velocity or displacement measurement exceeds the following values (when measurements are taken at the bearing supports using a vibration analyzer with the filter set at the operating fan speed):

<u>Fan Speed (RPM)</u>	<u>Maximum Vibration Level</u>
800 or Less	5 Mils (0.127 mm) max. displacement
801 and Greater	0.20 in/sec. (5 mm/s) max. velocity

- D. 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. Tops and bottoms of guards shall be of substantial sheet metal or not less than #18 U.S. standard gage. Braces or supports must not "bridge" sound and vibration isolators. Guards shall be designed with adequate provision for movement of motor required to adjust belt tension. Means shall also be provided to permit oiling, use of speed counters, and other maintenance and testing operations with guard in place. All direct drive equipment shall have coupling guards in accordance with Florida Department of Business Regulation safety regulations and OSHA.

2.10 BEARINGS

- A. All bearings shall be 200,000-hour rated unless otherwise specified.

PART 3 - EXECUTION

3.1 EQUIPMENT ACCESS

- A. Access Doors and Panels:

- 1. Locations: Provide access unit at the following locations.
 - a. Where additionally specified in other sections of this Divisions 22 and 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.

- B. Installation:

1. Definitions: For the purpose of coordination of responsibility, the following words are defined to describe the intended coordination.
 - a. "Furnish" means to procure an item and deliver it to the project for installation.
 - b. "Install" means to determine (in coordination with others as necessary) the intended appropriate location of an item and to set, connect and otherwise fix in place in a manner to allow intended operation and use.
 - c. "Provide" means to both furnish and install fully and completely in all aspects.
2. Furnishing Access Units: Access units shall be furnished as work of the Division which governs the item which is intended to be made accessible by the access unit.
3. Installing Access Units: Access units shall be installed as work of the Division which governs the surface, barrier, partition or other building component in and on which the access unit is to be placed.
4. Determination of Locations:
 - a. Where the work of Divisions 22 or 23 requires that the access unit be provided (i.e., both furnished and installed), then the responsibility for determination of the location at which the access unit is to be placed is also work of Divisions 22 and 23.
 - b. Where the work of Divisions 22 or 23 requires that access unit be furnished for installation as work of another Division, then the responsibility for determination of the location at which the access unit is to be installed shall be work of Divisions 22 and 23. Conversely, where the work of one Division requires that an access unit be only installed, then the responsibility for determination of the location of which the access unit is to be installed shall be work of Divisions 22 or 23 which furnishes the access unit.
5. Determination of Sizes:
 - a. Unless an access unit size is indicated on the drawings or otherwise specified, the size of each access unit shall be determined as work of the Division which either provides or furnishes the access unit.
 - b. Sizes for access units which are provided or furnished as work of this Division shall be in compliance with sizing criteria of this Division.

3.2 PAINTING

- A. Paint all exposed piping, ductwork, insulation, equipment, structural bases, racks, in occupied spaces, equipment rooms and on roof, furnished under Divisions 22 and 23 of these specifications. All exposed metal surfaces shall be given one prime coat and two finish coats. All insulated surfaces shall be given one sizing 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.
- B. Pipe hangers, saddles, supports, riser clamps and accessories shall be painted to match their piping.
- C. Equipment not completely accessible for painting when set in place shall be thoroughly cleaned and painted before installation and suitably protected.
- D. Piping concealed need not be painted.

3.3 HANGERS AND INSERTS

- A. Refer also to other sections which may describe additional requirements for hanging and supporting. Comply with the more stringent requirement if more than one method is specified or shown.
- B. Provide and properly locate hangers to adequately support piping and equipment. Arrange hangers to permit expansion and contraction.
- C. 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 a 16-gauge half-circle galvanized sheet metal insulation saddle.
- D. Isolation of copper pipe from steel hangers to consist of wrapping pipe at, and 1" each side of contact surface with not less than two layers of adhesive type plastic electrical insulating tape.
- E. Pipe supports for piping 2" diameter and below may be supported directly from Epicure steel decking using Epicure standard hangers (200 lb. max. load). Piping above 2" shall be supported from steel beams.
- F. Locate pipe supports as follows unless noted in other sections of these specifications or on the drawings:
 - 1. Horizontal cast iron pipe inside building – support on 5' centers or supported on 10' centers where 10-foot lengths of pipe are installed.
 - 2. Vertical cast iron pipe inside building - supported at each floor level and at the base but no more than 15'.
 - 3. Horizontal steel piping and copper tubing 1-1/4" diameter and under - support on 6' centers.
 - 4. Horizontal steel piping and copper tubing 1-1/2" diameter and larger- support on 10' centers.
 - 5. Horizontal steel piping and copper tubing larger than 1-1/2" diameter -support on 10' centers, except 24" diameter piping shall be supported by main roof beams (20' O.C. maximum).
 - 6. Support vertical cast iron, steel and copper piping at each floor penetration not to exceed 15 foot intervals.

3.4 ANCHORS

- A. 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 Architect/Engineer 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. Adequately insulate anchors on piping, with operating fluid temperatures below 75°F, to prevent moisture condensation problems.

3.5 EXPANSION AND CONTRACTION PROVISIONS

- A. Piping is designed with offsets and loops to provide for expansion and contraction. At such points, piping shall be cold sprung to equalize expansion when at operating temperatures. Install piping to maintain grade at all operating temperatures.

3.6 FLASHING

- A. Flashing shall be done as work of other divisions.

3.7 SLEEVES FOR PIPING

- A. Provide sleeves for all piping where pipe penetrations in walls, floors or other building structure are required. Sleeves in poured concrete shall have water tight seams and joints.
- B. Extend sleeves through walls, partitions and ceilings to finished surface. Extend sleeves through finished floors to not less than 1/4 inch above finished surface. Extend sleeves in concrete floors in chases to not less than 1 inch above floor top surface. Sleeves installed above finished ceilings as part of fire/smoke rated wall assemblies shall extend not less than 1" beyond both wall faces.
- C. Provide sleeves of adequate size to permit clearance for pipe movement and proper grading and sloping of pipes. Provide sleeves for insulated pipe of adequate size to clear insulation.
- D. Caulk space between sleeve's inner surface and pipe's outer surface (including insulation surface if pipe is insulated) with approved with fire rated safig material. Provide flexible fire retardant sealant if pipe is subject to expansion or contraction. Final result shall be an approved fire and smoke stop at pipe and sleeve assembly.
- E. Sleeves in walls and slabs subject to hydrostatic pressures shall be water tight at twice the hydrostatic pressure expected to be encountered at the location of the penetration.

3.8 SLEEVES FOR DUCTWORK

- A. Ductwork sleeves shall be provided in accord with current SMACNA recommendations or as otherwise detailed on Drawings. Refer also section describing duct systems.

3.9 ESCUTCHEONS

- A. Provide chrome plated brass escutcheons (for 1/4 or 1 inch projecting sleeves as required) at each point where an uninsulated pipe passes thru a finished surface.

3.10 CONCRETE BASES AND STRUCTURAL STEEL

- A. Concrete bases and structural steel to support equipment and piping installed under each specification section or division and not specifically shown on the structural or architectural plans shall be furnished for this work.

3.11 SEALANT

- A. Fire/smoke sealant shall be installed in strict compliance with the manufacturer's installation instructions.

END OF SECTION 23 05 00

SECTION 23 05 18 - PIPING: CONDENSATE DRAIN

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. Provide condensate drain piping from cooling coil drain pans.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division-23 and to all other applicable portions of the Drawings and Specifications.
- B. This section directly relates in particular to sections (which may or may not be included in this division) which describe the following:
 - 1. Air handling equipment with cooling coils.
 - 2. Insulation.

1.4 SHOP DRAWINGS

- A. Refer to Section entitled "General Mechanical Provisions".

PART 2 - PRODUCTS

2.1 PIPE

- A. Type L hard drawn copper conforming to ASTM Spec. B88.

2.2 FITTINGS

- A. Wrought copper, solder joint, pressure type conforming to ANSI B16.22.

2.3 SOLDER

- A. Composition SB5 (95/5), Fed. Spec. QQ-S-571d and Class 3 (Sil Fos), Fed. Spec. AA-S-561d, ASTM B32.

PART 3 - EXECUTION

3.1 GENERAL

- A. Piping shall be sloped uniformly toward drain, and provided with trap seal having a depth, in inches, equivalent to one and one-half (1-1/2) times the total static pressure of the respective fan system or as shown on details or as required by manufacturer's installation instructions, whichever is the most stringent. Traps shall be assembled using elbows and tees with threaded brass plugs to permit cleaning of trap and drain line. Piping shall be installed in a neat manner and shall be not smaller than full size of the equipment drain connection or three-quarters inch (3/4") whichever is larger.

3.2 JOINTS AND CONNECTIONS

- A. General: Joints and connections shall be made permanently air, gas, and water tight.
- B. Solder Joints: Cut pipe square using cutting tool which does not crimp pipe. Remove all burrs using pipe reamer and taking care not to flare the pipe end. Thoroughly clean the outside of pipe and the interior of the fittings using a fine sand cloth. Apply noncorrosive paste flux to the cleaned surfaces immediately and apply solder and heat, in accordance with manufacturer's instructions, to complete joint.
- C. Equipment Connections: Connections to copper drain nipples may be made with solder joints provided care is exercised not to damage equipment, its insulation or finish. Connections to equipment having steel nipples shall be made using screwed to solder adapters with teflon tape applied to male threads prior to assembly.

3.3 ROUTING

- A. Unless otherwise indicated, route pipe discharge as follows:
 - 1. Roof Mounted Equipment: To nearest roof drain.
 - 2. Interior Equipment: To nearest floor or hub drain.

3.4 INSULATION

- A. Insulate if so specified in section describing insulation.

END OF SECTION 23 05 18

SECTION 23 05 19 FLOW METERS AND GAUGES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. Provide pressure gauges, gauge valves, test plugs, snubbers and similar devices for indication of operating conditions of such points as are indicated on drawings and as specified herein.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division-23 and to all other applicable portions of the drawings and specifications.
- B. This section directly relates in particular to sections (which may or may not be included in this division) which describe the following:
 - 1. Thermometers.
 - 2. HVAC piping systems.
 - 3. All HVAC equipment through which fluid flows and at which fluid pressures may need to be determined.

1.4 SHOP DRAWINGS

- A. Refer to Section entitled "General Mechanical Provisions". Provide schedule of ranges and proposed locations.

PART 2 - PRODUCTS

2.1 GAUGES

- A. Four and one-half inch (4-1/2") diameter with cast aluminum black finish flangeless case and chrome ring. Bourdon tube: phosphor bronze, silver soldered to socket and tip. Socket: forged brass bottom outlet type. Movement: stainless steel rotary type with delrin sector and bushings and micrometer type pointer. Acceptable: H.O. Trerice Co. 500X or an equivalent.
- B. Where Permanent Gauge is Installed: Brass, needle valve, round knurled handle, 1/4" male x 1/4" female NPT. Acceptable: H. O. Trerice Co. 735 Type FFG, or equivalent.
- C. Where Permanent Gauge is Not Installed: Brass gate valve 1/4" female NPT. Acceptable: Crane No. 438 or NIBCO No. T-113, or equivalent.

2.2 PRESSURE SNUBBER

- A. Brass, 1/4" male x 1/4" female NPT. Acceptable: H. O. Trerice Co. 872-2, or equivalent.

2.3 COILED SYPHON PIGTAILS

- A. Single turn 360 degree coil, arranged with plane of coil parallel to its flow, constructed of 1/4" tubing with male NPT threads on both end extensions. Acceptable: H. O. Trerice Co. 885-series.

2.4 TEMPERATURE/PRESSURE TEST PLUGS

- A. Use at Contractor's option as specified in Part 3 of this section. Body of brass or 316 stainless steel. Valve core of neoprene for applications to 200°F and of Nordel for applications to 275°F. Rated for pressure to 1000 psig. Screwed hexagonal cap and gasket. Size 1/4" NPT or 1/2" NPT as applicable. Length 1-1/2" or 3" as applicable to penetrate and allow for insulation. Designed for taking temperature and pressure readings when used with recommended probes. Acceptable: Pete's Plug, Standard or XL Size as manufactured by Peterson Equipment Company, Inc., Richardson TX 75081; Sisco P/T Plugs; or equivalent.
 - 1. Test Kit: Provide Owner with one companion test kit suitable for taking temperature and pressure readings with test plugs. Provide to Architect/Engineer written certification of delivery of test kit to Owner; certification shall be signed by Owner's authorized representative.

2.5 INSERTION ELECTROMAGNETIC FLOW METER

A. Description:

- 1. No moving parts, suitable for pipe sizes 1¼" to 72", continuous auto-zero function. And transmitter integral to meter.
- 2. Suitable for flow measurement of fluids with electrical conductivity between 20 to 60000 micro-Seimens per centimeter.
- 3. Wet calibrate and tag meters to standards traceable to NIST, and provide each meter with a certificate of calibration.

B. Performance:

- 1. Flow Range: 0.25 to 20 fps.
- 2. Accuracy for Velocities between 2 and 20 fps: Within 1 percent of reading.
- 3. Accuracy for Velocities Less than 2 fps: Within 0.02 fps.
- 4. Ambient Temperature: Minus 5 to 150 deg F.
- 5. Process Temperature: 15 to 250 deg F.
- 6. Pressure: 400 psig.

C. Output Signals:

- 1. Field-selectable analog signals.
 - Current Signal (Isolated): 4 to 20 mA.
 - Voltage Signal (Isolated): Zero- to 10V dc.
- 2. Digital Signal: Dry-contact closure signaling fault condition.
- 3. Frequency Signal: Zero- to 15-V peak pulse, zero to 500 Hz.
- 4. Scalable Pulse Output:
 - Isolated solid-state dry contact.
 - Contact Rating: 100 mA at 50-V dc.
 - Pulse Duration: 0.5, 1, 2, or 6 seconds

D. Basis of Design: Onicon F-3500 or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install pressure gauges, gauge valves, test plugs and snubbers in accordance with manufacturer's instructions and locate in such a manner as to permit easy reading of all gauges associated with a single piece of equipment from a single point on the floor (or working platform).

3.2 PRESSURE GAUGES

- A. Install in such a manner as to give an accurate reading of the actual conditions and to permit easy access to gauge and gauge valve. Where mounting location does not permit rotation of the gauge for removal, install using the union type (880) gauge valve. Range shall be selected to read near center at normal operating conditions.

3.3 GAUGE VALVE

- A. Install using brass nipples of sufficient length to raise gauge valve clear of insulation and finish.

3.4 SNUBBER

- A. Provide on all gauges at suction and discharge of all pumps and elsewhere as required to prevent pulsation.

3.5 COILED SYPHON PIGTAIL

- A. Provide on pressure gauges used to steam service. Install pigtails and gauges vertically.

3.6 LOCATIONS NOT SHOWN ON DRAWINGS

- A. Provide as described in this section unless individual locations are otherwise shown on drawings.

3.7 PERMANENT PRESSURE GAUGE LOCATIONS

- A. Provide permanent gauges, with gauge valves, at the following locations:
 - 1. Fluid inlet and outlet of:
 - a. Each water coil in each air handling unit.
 - b. Hydronic system strainers in main piping system (not required at strainers which may be located at individual air handling units or similar equipment unless otherwise indicated).
 - c. Each air separator.
 - d. Each water inlet and outlet at each chiller.
 - 2. Suction and discharge of each pump.
 - 3. Where otherwise indicated.

3.8 GAUGE VALVE ONLY LOCATIONS

- A. Provide gauge valves to permit temporary or permanent installation of gauges for pressure indication at the following locations:
 - 1. Inlets and outlets of water coils at:

- a. Each fan coil unit.
- b. Each terminal unit hot water coil.
- c. Where otherwise indicated.

3.9 TEMPERATURE/PRESSURE TEST PLUGS

- A. Where a gauge valve and a thermometer well is indicated as a pair (i.e., side by side), Contractor may at his option, provide only a single test plug. Provide only at the following location (at Contractor's operation in lieu of the gauge valves specified above and in lieu of thermometer wells specified in "Thermometers" section):
 - 1. Inlets and outlets of each coil at each terminal unit.
 - 2. Inlet and outlet of each coil in each fan coil unit.

3.10 LIQUID FLOW METERS

- A. Install meters in straight sections of piping with manufacturer-recommended straight piping upstream and downstream of sensor.
- B. Install system process connections full size of meter connection, but not less than 1 inch pipe. Provide stainless-steel bushing if required to mate to system connection.
- C. Install meter in top dead center of horizontal pipe positioned in an accessible location to allow for inspection and replacement.
- D. In applications where top-dead-center location is not possible due to field constraints, install meter at location along top half of pipe if acceptable by manufacturer for mounting orientation.

3.11 PROTECTION OF EQUIPMENT

- A. Protect equipment from damage from time of its receipt until final acceptance and shall thoroughly clean the pressure gauges, gauge valves and like items of all dirt and construction debris prior to requesting final inspection. Gauges which become damaged during the course of construction shall be repaired to "as new" condition or shall be replaced with new equipment.

END OF SECTION 23 05 19

SECTION 23 05 20 - PIPING SYSTEMS: FLUSHING AND CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. Completely flush and clean the new piping systems for chilled water and heating hot water systems prior to making final connections **to the existing central system to the cooling plants, heating plants, cooling coils and heating coils**. Provide all plant, materials, equipment and labor required to flush and clean piping systems prior to operation.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division-23 and to all other applicable portions of the Drawings and Specifications.

1.4 SHOP DRAWINGS

- A. Include specific data on: all chemicals, feeders, blow down valves and like items; as well as complete piping diagrams. Include complete description of methods.

1.5 PRESSURE AND TEMPERATURE RATINGS

- A. Unless otherwise specified in this section, components specified by this section shall be recommended and rated for same (or greater) maximum working pressure and temperature conditions which are applicable to the fluid system at the location(s) at which the equipment and systems of this section are installed. Refer to specification section(s) describing the related fluid systems(s) for pressure and temperature ratings applicable to the components of this section.

1.6 MANUFACTURER'S QUALIFICATIONS

- A. The water treatment chemical supplier shall be a recognized specialist, active in the field of industrial water treatment for at least ten years.

PART 2 - PRODUCTS

2.1 SHOT FEEDER

- A. Provide a temporary shot feeder installed across the pumping system suction and discharge sides to allow injection of cleaning chemicals into the system.
- B. Shot feeders shall be Mogul, Mitco, Garrett Callahan, Culligan, Nalco, Griswold or equivalent.

2.2 WATER TREATMENT CHEMICALS

- A. Formulation shall not contain any ingredients which are harmful to system materials.
- B. Chemicals shall be supplied by Mogul, Mitco, Garrett Callahan, Culligan, Nalco or equivalent.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install chemical feeding systems as indicated, in accordance with manufacturer's installation instructions, to comply with requirements and intended purposes.

3.2 SHOT FEEDER

- A. Install shot feeder with adequate pressure differential to permit flow through the chemical feeder body. Connect feed piping to inlet and outlet connections with shutoff valves. Pipe drain valve discharge to drain.
- B. Provide all hardware and chemicals for start-up of system and full operation of initial system fill.
- C. Connect water treatment piping system to mechanical systems and comply with equipment manufacturer's instructions where not otherwise indicated. Install shutoff valve and union or flanges on supply and return, drain valve on drain connection.

3.3 CLEANING AND FLUSHING

- A. All piping lines and related equipment shall be thoroughly flushed out with precleaning chemicals designed to remove deposition such as pipe dope, oils, loose rust and mill scale and other extraneous materials. Add recommended dosages of precleaner chemical products and circulate throughout the water system. Feed chemicals at the proper feed rates, check that the cleaning solution is actually in each system, flush the system and shall check each system following flushing to insure all cleaning chemicals have been removed from each system. Open all modulating valves, zone valves and all other system restrictions. Drain, fill and flush system until no foreign matter is observed.
- B. Chemical used for cleaning of systems shall comply with the recommendations of the manufacturers of the major components in the system.
- C. Permanent facility pumps shall not be used for circulating cleaning water. Provide temporary pumps for this process. If the system construction, flow rates, and pressures are such that it is impractical to provide temporary pumps, the permanent facility pumps may be used with the specific express permission of the Owner, provided the guarantee on the entire pump assembly is unconditionally extended for two years after date of Substantial Completion. Leakage from pump seals or other damage resulting from circulating the uncleaned water shall require immediate rectification at no additional cost to the Owner.
- D. A certificate of cleaning shall be provided by the cleaning chemical supplier to the Owner.

3.4 PIPING

- A. Installation of piping shall be made in a manner which provides for all drains and temporary connections necessary to clean and flush the new piping systems.

3.5 OTHER REQUIREMENTS

- A. Provide all necessary pipe, valves, fittings, unions and other items necessary for proper installation and removal of all components needed to clean and flush the system.

- B. Locate temporary shot type feeder in valved bypass from pump discharge to pump suction. Provide gate valve in bypass on each side of feeder.

END OF SECTION 23 05 20

SECTION 23 05 21 - THERMOMETERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. Provide thermometers and wells for temperature indication at such points as indicated on drawings and as specified herein.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division-23 and to all other applicable portions of the drawings and specifications.
- B. This section directly relates in particular to sections (which may or may not be included in this division) which describe the following:
 - 1. Gauges.
 - 2. HVAC piping systems.
 - 3. All HVAC equipment which contains heat transfer components where fluid temperatures may need to be determined.

1.4 SHOP DRAWINGS

- A. Refer to section entitled "General Mechanical Provisions". Provide schedule of ranges and proposed locations.

PART 2 - PRODUCTS

2.1 THERMOMETERS

- A. Adjustable angle, nine inch (9") long scale, organic fluid type with range selected to read center scale at normal operating conditions; extension necks and bulb style selected to suit application; armored elements on duct thermometers. Acceptable: H.O. Trerice Co BX93403 or equivalent.

2.2 SEPARABLE SOCKETS

- A. Provide for each thermometer in piping system. Sockets: Brass with extension neck to suit thickness of insulation and finish 3/4" NPT.

2.3 THERMOMETER TEST WELLS

- A. Brass with extension neck to suit insulation cap with chain; 1/2" NPT; extension neck where necessary to penetrate insulation.

2.4 TEMPERATURE/PRESSURE TEST PLUGS

- A. Use at Contractor's option as specified in Part 3 of this section. Body of brass or 316 stainless steel. Valve core of neoprene for applications to 200°F and of Nordel for applications to 275°F. Rated for pressure to 1000 psig. Screwed hexagonal cap and gasket. Size 1/4" NPT or 1/2" NPT as applicable. Length 1-1/2" or 3" as applicable to penetrate and allow for insulation. Designed for taking temperature and pressure readings when used with recommended probes. Acceptable: Pete's Plug, Standard or XL Size as manufactured by Peterson Equipment Company, Inc., Richardson, TX 75081; Sisco P/T plugs; or equivalent.
- 1. Test Kit: Provide Owner with one companion test kit suitable for taking temperature and pressure readings with test plugs. Provide to Architect/Engineer written certification of delivery of test kit to Owner; certification shall be signed by Owner's authorized representative. Duplicate test kit is not required under this section if provided under section describing gauges.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install test wells, separable sockets, and thermometers in accordance with manufacturer's instructions. Locate in such a manner (adjusting mounting angle as required) as to permit easy reading of all thermometers associated with a single heat transfer device from a single point on the floor (or working platform).

3.2 THERMOMETERS IN PIPING SYSTEMS

- A. Install in such a manner as to give accurate reading of actual conditions. Make allowance for proper (unrestricted) flow by installing in oversized fitting in line sizes two inches (2") and under.

3.3 THERMOMETERS IN DUCT SYSTEMS

- A. Install in such a manner as to give accurate reading of actual conditions.

3.4 PROTECTION OF EQUIPMENT

- A. Protect equipment from damage from time of receipt until final acceptance. Thoroughly clean thermometers, wells and like items of all dirt and construction debris prior to requesting final inspection. Thermometers which become damaged during course of construction shall be repaired to "as new" condition or shall be replaced with new equipment.

3.5 LOCATIONS NOT SHOWN ON DRAWINGS

- A. Provide as described at locations in this section unless individual locations are otherwise specifically shown on drawings.

3.6 THERMOMETER LOCATIONS

- A. Provide permanent thermometers and companion wells at the following locations:
 - 1. Fluid inlet and outlet of:
 - a. Each water coil in each air handling unit.
 - b. Each water inlet and outlet of each chiller.

2. Where elsewhere specified or indicated on the drawings.

3.7 THERMOMETER TEST WELL LOCATIONS

A. Provide thermometer test wells at:

1. Inlets and outlets of each water coil at each unit which is not a packaged air handling unit or a built-up air handling unit (i.e., terminal unit hot water coils, fan coil unit coils, duct mounted hot water coils and similar units).
2. Where elsewhere specified or indicated on the drawings.

3.8 TEMPERATURE/PRESSURE TEST PLUGS

A. Where a thermometer well and a gauge cock is indicated together as a pair (i.e. side by side), Contractor may, at his option, provide only a single test plug is required. Provide only at the following locations (at Contractor's option in lieu of the test wells specified above and in lieu of the gauge cocks specified in "Gauges" section).

1. Inlets and outlets of each water coil at each unit which is not a packaged air handling unit or a built-up air handling unit (i.e. terminal unit hot water coils, fan coil unit coils, duct mounted hot water coils and similar units.)
2. Where elsewhere specified or indicated on the drawings.

3.9 ADDITIONAL INSTALLATION REQUIREMENTS

- A. Install near pressure gauge cocks and flow meter ports where practical but not to deflect flow and cause raise readings of such other instruments.
- B. Install to cause least possible condensation.
- C. Thermometers shall be easily readable by person in normal position; adjust mounting configuration accordingly.
- D. Provide pipe extensions where installation is in pipe with diameter smaller than insertion length or install in oversized pipe sections.
- E. Install thermometers and test wells as follows so that wells will hold gauge oil without spilling when wells are being used for testing and balancing:
 1. In horizontal pipe so that the well is in the top quadrant of the pipe and is not less than 45° from vertical.
 2. In vertical pipe so that the well is 45° from vertical.

END OF SECTION 23 05 21

SECTION 23 05 23 - VALVES, COCKS AND SPECIALTIES: HVAC SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. Provide those valves, cocks and specialties which are required for the HVAC piping systems. These items include, but are not necessarily limited to, the following:
 - 1. Gate valves.
 - 2. Check valves.
 - 3. Ball valves.
 - 4. Cocks and plug valves.
 - 5. Drain valves.
 - 6. Butterfly valves.
 - 7. Backflow preventers.
 - 8. Strainers.
 - 9. Safety valves.
 - 10. Pressure relief valves.
 - 11. Air vents.
 - 12. Flow indicating/balancing valves.
 - 13. Automatic flow-control valves.
 - 14. Pump suction guide/strainer/elbows.
 - 15. Pump discharge/flow control valves.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of the Division-23 and to all other applicable portions of the drawings and specifications.
- B. This section directly relates in particular to sections (which may or may not be included in this division) which describe the following:
 - 1. Piping systems.
 - 2. Pumps.
 - 3. Insulation.
 - 4. Equipment connected to piping systems in which work of this section is applicable.
 - 5. Air control equipment.
 - 6. Work which is described in Divisions 22 and 23 which relate to the plumbing systems and which requires valves, cocks and specialties shall be provided in compliance with this Section unless requirements of Divisions 22 and 23 specifically state otherwise.

1.4 APPLICABLE SYSTEMS

- A. These valves, cocks and specialties are intended for application in, but not necessarily limited to, the following HVAC piping systems as applicable to this project.

LINE 1
LINE 2

NO.

1. Chilled water systems.
2. Hot water systems.
3. Condenser water systems.
4. Steam systems.
5. Other related HVAC piping systems.

1.5 VALVES, COCKS AND SPECIALTIES

- A. Valves, cocks and specialties may not be indicated in every instance on the drawings, but whether or not shown, all valves, cocks and check valves necessary to the proper operation of the system shall be furnished and installed in an approved manner and location. Valves shall have rising stems except in locations where space is limited; in these locations non-rising stem valves of equivalent material and pressure class will be accepted.

1.6 ACCEPTABLE MANUFACTURERS

- A. Products listed in this Section or on the plans are based on a specific manufacturer to establish the desired style, quality and type. Equivalent products, complying with the requirements of this Section and the installation requirements of the plans, by the following manufacturers are acceptable:

1. Mueller
2. Hammond
3. Crane
4. Powell
5. Walworth
6. Lunkenheimer
7. Stockham
8. Williams-Hager
9. APCO
10. Metraflex
11. ACFR
12. Apollo International
13. Centerline
14. Demco
15. Gerand
16. Griswold
17. Aeroquip
18. Dezurick
19. Watts,
20. Maxwell & Moore
21. Bell & Gossett
22. Beaton-Cadwell
23. McDonnell Miller
24. Maid-O-Mist
25. Sarco
26. Armstrong
27. Nibco
28. Jamesbury
29. Taco
30. Wheatley Pump & Valve
31. Conbraco
32. Grinnell
33. McDonald
34. Flow Design

35. HCI; Hydronics Components, Inc.
36. Nexus Valve, Inc.
37. Hays Fluid Controls
38. NuTech

- B. Any model numbers listed are from one or more of these manufacturers and are given to provide an example of the item(s) required.

1.7 INDUSTRY STANDARDS

- A. Where compliance with an industry, society or association standard is specified or indicated, certification of such compliance shall be submitted with shop drawings.

1.8 PRESSURE AND TEMPERATURE RATINGS

- A. Temperature: Unless otherwise specified, ratings shall be as follows for all components specified herein.

1. Chilled water systems: 150°F
2. Hot water systems: 200°F
3. Condenser water systems: 150°F
4. Steam systems:
 - a. Low pressure (LPS): 275°F
 - b. Medium pressure (MPS): 300°F
 - c. High pressure (HPS): 350°F

- B. Pressure: Unless otherwise specified, all components must be of pressure class and rating to be recommended for operation at the following maximum allowable non-shock pressure ratings.

1. Chilled water systems: 150 psig
2. Hot water systems: 150 psig
3. Condenser water systems: 150 psig
4. Steam systems:
 - a. Low pressure (LPS): 150 psig
 - b. Medium pressure (MPS): 150 psig
 - c. High pressure (HPS): 200 psig

PART 2 - PRODUCTS

2.1 GATE VALVES

- A. 3" and smaller: Threaded or solder pattern as applicable, rising stem, iron wheel, rough brass body, solid wedge disc, screwed or union bonnet and finished gland nut, 150 psi class. Types as follows:

1. Threaded Pattern: Crane 431, Powell 514S, Walworth 56, Lunkenheimer 2151, Stockham B-122.

LINE 1
LINE 2

NO.

2. Soldered Pattern: Powell 1842S, Lunkenheimer 2151, Stockham B-124.
 - B. 3-1/2" and Larger: Flanged, cast iron body, brass trim, brass seats, rising stem and iron wheel, 125 psi class. Types as follows: Crane 465-1/2, Powell 1793, Walworth 726F, Lunkenheimer 1430, Stockham G-623.
- 2.2 GLOBE VALVES
- A. 2-1/2" and Larger: Flanged, iron body, yoke bonnet, bronze trim and disc.
 - B. 2" and Smaller: Screwed, bronze body, union bonnet composition disc.
- 2.3 CHECK VALVES
- A. Swing type:
 1. 3-inches and Smaller: Threaded or solder pattern as applicable, pressure rating of not less than 200 psi threaded pattern and 125 psi solder pattern, wye pattern swing check, rough brass body, finished gland nut, regrinding bronze disc.
 2. 4-inches and Larger (125 psi maximum working pressure): Flanged pattern, iron body, swing check, renewable brass seat, disc and trim. Types: Crane 373, Powell 559, Walworth M-928F, Lunkenheimer 1790, Stockham G-931.
 3. 4-inch and Larger (200 psi maximum working pressure): Flanged brass-ferrosteel body, swing check, renewable brass seat, disc and trim. Types: Crane 39E, Powell 576, Walworth M-970F, Lunkenheimer 323.
 - B. Wafer Type:
 1. 3-inch and Larger: Flanged pattern, globe type, semi-steel body, stainless steel spring, bronze disc and bronze seat ring. Types: Williams-Hager Figure 636; APCO Series 600; Mueller Nos. 105, 107, 109 and 113; Metraflex Series 900.
- 2.4 PLUG VALVES AND BALANCING COCKS
- A. General: Semi-steel, lubricated type, bolted cover or gland, position indication dial, full port, teflon coated plug. Over 6-inches shall have a geared or worm drive operator.
 - B. 2 inches and Smaller: Screw pattern Powell F-2200, Walworth 1700, ACF R1430.
 - C. 2-1/2 inches and Larger: Flanged end. Powell F2201, Walworth 1700F, ACF R 1431.
- 2.5 DRAIN VALVES
- A. General: Use only for low pressure drainage service.
 - B. 2 inches and Smaller: Either threaded or soldered ends, class 125, bronze body, screwed bonnet, rising stem, disc with 3/4" hose thread outlet connect.
 1. Threaded Pattern: Crane 410, Stockham B-100.
 2. Soldered Pattern: Crane 1320, Stockham B108.
- 2.6 BUTTERFLY VALVES

- A. Pattern: Valves shall be of the threaded lug body type. All valves shall have extended necks for insulation clearance.
- B. Body: Semi-steel or cast iron or pattern specified hereinbefore.
- C. Disc: Bronze or semi-steel with welded nickel edge, 416 stainless steel shaft, bronze bearings, and Hycar seals.
- D. Seat: Hycar, bonded to a rigid reinforcing ring which is held in place by a metal retaining ring. All valves shall be capable of bubble tight shut-off at pressure differentials of 200 psig, and 200 psig dead end shut-off.
- E. Operators: Valves 2" through 6" shall have lever type actuator capable of infinite position (or minimum of 10 locking positions) and shall have adjustable memory stop. Valves 8" and larger shall have gear type actuator with chain wheel, hand wheel or crank type operating mechanisms, adjustable opening and closing memory stops, and position indicator. All valves 4" and larger located more than 6'-0" above the floor shall be provided with chain wheel and chain. Provide stem extensions (in addition to insulation clearance extension specified hereinbefore) as required to place operators in an easily accessible location free of interference with adjacent piping, equipment structure, and the like.
- F. Manufacturers: Grinnell, Keystone, Center-Line, Demco, DeZurick.

2.7 BALL VALVES

- A. 2-1/2 inches and Smaller: Threaded or soldered ends, port area equal to or greater than connecting pipe diameter, Class 125, two piece bronze body, bronze ball, bronze stem, teflon seat and seals. Acceptable manufacturers; Crane, Hammond, Jamesbury, Nibco, Stockham, and Walworth.

2.8 CALIBRATED BALANCING AND FLOW MEASURING VALVES

- A. 1/2" to 2": Globe type providing flow balancing, flow measurement, positive shut off, and drain connection. Balancing valves shall be provided with vernier-type setting with adjustment range through four 360 degree turns of handwheel. Valves shall have hidden memory feature to prevent tampering. Valves shall be provided with meter connections having positive shut off valves. All metal parts shall be of nonferrous, pressure die-cast, nonporous Ametal Copper Alloy. Valve shall provide accurate flow control regardless of valve orientation. Provide form-fitting polyurethane insulation cover. Design basis Armstrong CBV I. Acceptable Alternates: Accepted equivalents by Bell & Gossett, Hays Fluid Controls, Taco, and Preso.
- B. 2-1/2" to 6": Globe type providing flow balancing, flow measurement, and positive shut off. Balancing valves shall be provided with vernier-type setting with adjustment range through eight 360 degree turns of handwheel. Valves shall have hidden memory feature to prevent tampering. Valves shall be provided with meter connections having positive shut off valves. Valves shall be cast iron with brass trim. Design basis Armstrong CBV II. Acceptable Alternates: Accepted equivalents by Bell & Gossett, Hays Fluid Controls, Taco and Preso.
- C. Provide Owner: One portable differential pressure gauge kit of same manufacturer as valves. Kit shall be housed in a hand-carrying case and shall contain one 0-135" W.C. and one 0-60 foot pressure gauge, 5 foot meter hoses with disconnect ends, positive shutoff valves, operating instructions, and flow versus pressure drop curves for each size valve installed.

2.9 AUTOMATIC FLOW-CONTROL VALVES:

- A. Body: Brass or ferrous metal.

LINE 1
LINE 2

NO.

- B. Flow Control Assembly: Piston and spring assembly or elastomeric diaphragm and polyphenylsulfone orifice plate. Stainless steel or corrosion resistant, tamper proof, self-cleaning, and removable.
- C. Combination Assemblies: Include bronze or brass-alloy ball valve.
- D. Identification Tag: Marked with zone identification, valve number, and flow rate.
- E. Size: Same as pipe in which installed.
- F. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
- G. Minimum CWP Rating: 300 psig.
- H. Maximum Operating Temperature: 225 deg F.
- I. Provide with removable cartridge without the use of special tools or cutting piping. Provide two extended pete ports on each valve to clear insulation.
- J. Provide integral union on the downstream side of the assembly and with electronic pressure (0-75 psi) and temperature (-10 - 230 F) test kit.

2.10 STRAINERS

- A. General: Y-type.
- B. Body: Cast iron, ductile iron, cast or forged steel as required for specified working pressure of piping system.
- C. Screen: 315 stainless steel or monel. Free area not less than three times inlet area.
 - 1. Perforations: 1/8" mesh for sizes to 8-inches. 5/32" mesh for sizes 10-inches and larger.
- D. Connections:
 - 1. Straight thread and gasket to 2-inch size.
 - 2. Flanged 2-1/2 inches and larger.
 - 3. Solder pattern when used in copper piping systems.
- E. Bolted cover in 2-1/2 inch and larger.
- F. Gate Valve: On 2-1/2 inch size and larger, provide a gate valve on each strainer cover blowdown connection; gate valve to be full size of blowdown connections.

2.11 SAFETY VALVES

- A. General: ASME rated as shown on the drawings and/or required by applicable codes.
- B. Manufacturers: Manning, Maxwell & Moore, Watts Regulator, or Bell & Gossett Co.

2.12 PRESSURE RELIEF VALVES

- A. One-half (1/2) or three quarter (3/4) inch size, brass, iron or steel, ASME rated.

2.13 AIR VENTS

A. Automatic:

1. 150 psi Working Pressure: Metraflex MV-15, Crane 976, Sarco 13W, Armstrong 1AV.
2. 75 psi Working Pressure: Maid-O-Mist #7, Bell & Gossett #7, Hoffman 79.

B. Manual: Brass manual cock, Crane 700 Series, with hose thread adapter.

2.14 PUMP SUCTION GUIDE/STRAINER ELBOW

A. Sizes Allowable: 2" through 12".

B. Construction: At the Contractor's option, in lieu of strainer and long sweep elbow, provide at each pump a suction guide/strainer elbow. Units shall consist of cast iron angle type body (175 psi pressure rated) with cast iron inlet vanes and a combination stainless steel diffuser strainer with 3/16" or 1/3" diameter openings for pump protection. (Unit shall be equipped with a disposable brass or bronze fine mesh start up strainer which shall be removable after 30 days). The body outlet pipe size shall be equal to the pump suction pipe size. The unit shall be provided with an adjustable support foot to relieve piping strains from the pump suction, threaded pressure gage tap at the body inlet and blowdown tapping in bottom.

C. Acceptable Manufacturers: Armstrong Pumps, Inc., Taco, Inc.; Bell & Gossett or equivalent.

2.15 PUMP DISCHARGE/FLOW CONTROL VALVES

A. Allowable Sizes: 1-1/2" through 10".

B. Construction: At Contractor's option, install pump discharge valves on each pump discharge line in lieu of separate shutoff valve, check valve, and balance cock. Pump discharge flow control shall be cast-iron valve body, pressure rated for 175 psi, maximum operating temperature of 300°F. Provide check valve and calibrated adjustment feature permitting regulation of pump discharge flow and shutoff. Bronze gland, stainless steel stem, brass or bronze seat, graphited asbestos packing or double "O" ring seal straight or angle pattern. Angle pattern valves shall be provided with adjustable support foot.

C. Acceptable Manufacturers: Armstrong Pumps, Inc., Bell & Gossett; Taco, Inc.; or equivalent.

PART 3 - EXECUTION

3.1 GENERAL

A. Install valves in horizontal piping with the valve stem in the vertical upright position.

B. Install valves to provide adequate clearance to permit easy operation of the valve hand wheel and permit servicing of the valve packing.

C. Provide blow down valve on 1-1/2" and larger strainers (except refrigerant piping). Use valve not less than 1/2 strainer blow down outlet size.

3.2 VALVES AND COCKS

LINE 1
LINE 2

NO.

- A. All valves, balancing cocks and similar items shall be installed in an easily accessible location. Provide access panels for all concealed valves. Where isolation valves are indicated on the drawings, provide butterfly valves, provided they are in compliance with these specifications. Where butterfly valves are used, they shall be installed between properly spaced flanges, then run to the full open position before mounting bolts are tightened in order to insure a balanced pressure on the seat and prevent distortion.

3.3 PRESSURE RELIEF VALVES

- A. Install pressure relief valves where specified or indicated on the drawings. Pipe to spill over floor drain or service sink. Provide pressure expansion device for all valves set for 150-psig or greater.

3.4 PUMP DISCHARGE FLOW CONTROL VALVES

- A. Where such valves are used, install pump discharge/flow control valves on each pump discharge. Install in horizontal or vertical position with stem in upward position; allow clearance above stem for check valve mechanism removal. After hydronic system has been completed, mark calibrated name plate with stripe of yellow lacquer to permanently mark final balanced position.
- B. Install adjustable foot support for angle pattern valves to carry weight of discharge piping.

3.5 SAFETY VALVES

- A. Safety valves to have valve spindle enclosure with gland seal to minimize leakage and manual lift lever to check discharge required. Cut discharge pipe from safety valve on a 45 degree angle, pipe to floor and direct toward or into floor drain (unless noted otherwise on the drawings).

3.6 AUTOMATIC AIR VENTS

- A. Install automatic air vents with inlet isolation cock at locations indicated on drawings and at high points of hot and chilled water piping systems. Pipe vent discharge to drain pan, plumbing trap or to outside of building.

3.7 DRAIN VALVES

- A. Install drain valves at the base of all water piping risers (both supply and return) and at all low points in the piping system.

3.8 BALL VALVES

- A. Ball valves may be installed in lieu of butterfly valves for all isolation valve service.

3.9 VALVED GAUGE CONNECTIONS

- A. Provide valved gauge connections at diffuser inlet and pump suction to indicate when cleaning is needed. Install on pump suction inlets, adjust foot support to carry weight of suction piping. Install nipple and shutoff valve in blowdown connection. After cleaning and flushing hydronic piping system, but prior to balancing of hydronic piping system, remove disposable fine mesh strainer.

3.10 CALIBRATED BALANCING AND FLOW MEASURING VALVES

- A. Provide flow indicating balancing valves where shown on drawings. The locations shown on drawings or otherwise indicated are diagrammatic in nature and are intended basically to show the requirement for flow measurement and shut-off relative to a specific piece of equipment or portion of the system

and not the exact physical location of the device. The exact physical location shall be determined using field measurements relating to the specific piping arrangement and the manufacturer's recommendations relating to upstream and downstream clearances. Install in accordance with manufacturer's recommendations including increases or decreases in pipe size at points of installation together with minimum recommended lengths of straight run pipe before and after points of installation. Balancing shall be done, using the master meter specified hereinbefore, as work of the section describing test and balance. At the conclusion of the test and balance work the meter shall be turned over to, and shall become the property of, the Owner.

3.11 MECHANICAL ACTUATORS

- A. Install mechanical actuators with chain operators where indicated, and where valves 4" and larger are mounted more than 7'-0" above floor in mechanical rooms, chiller rooms, boiler rooms; and where recommended by valve manufacturer because of valve size, pressure differential or other operating condition making manual operation difficult.

3.12 AUTOMATIC FLOW-CONTROL VALVES

- A. Install as indicated on details. The exact physical location shall be determined using field measurements relating to the specific piping arrangement and the manufacturer's recommendations relating to upstream and downstream clearances. Install in accordance with manufacturer's recommendations including increases or decreases in pipe size at points of installation together with minimum recommended lengths of straight run pipe before and after points of installation.

END OF SECTION 23 05 23

SECTION 23 05 29 - HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this Section.

1.2 SCOPE

- A. Provide all angles, brackets, clamps, anchors, inserts, rods, braces, frames, hangers nuts and bolts, and other miscellaneous steel and hardware items as may be required for the proper support of equipment, piping systems, HVAC systems, plumbing systems and fire protection systems.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Divisions 22 and 23 and to all other applicable portions of the Drawings and Specifications.
- B. This section directly relates in particular to sections (which may or may not be included in this division) which describe the following:
 - 1. Piping systems.
 - 2. Duct systems.
 - 3. Equipment items.

1.4 SHOP DRAWINGS

- A. Refer to Section entitled "General Mechanical Provisions". Provide specific data on hangers, stands, clamps, rollers, guides, shields, anchors and their proposed application. Submit detailed shop drawings, showing method of support and anchoring for all piping and equipment as follows:
 - 1. Piping Systems:
 - 2. Scaled single line piping plans superimposed on structural construction drawings. Scale shall be minimum 1/4" = 1'-0". Piping which is three inch (3") diameter and smaller may be omitted from these shop drawings. Drawings shall clearly indicate the location and type of each and every insert, hanger, stand, support, guide, isolator and anchor; and shall also indicate the size, type locations and method of attachment for all miscellaneous structural steel required.
 - 3. Sectional drawings, sketches and other details as may be required to clearly communicate the method of support, anchoring, guiding and vibration isolation.
 - 4. Show details of any typical floor or wall penetrations including: riser clamp, pipe sleeve, and provisions for water stop to prevent the water travel between penetrations.

1.5 INDUSTRY STANDARDS

- A. Where compliance with an industry, society or association standard is specified or indicated, certification of such compliance shall be submitted with shop drawings.

1.6 MANUFACTURER

- A. Products listed in this Section or on the plans are based on a specific manufacturer to establish the desired style, quality and type. Equivalent products, complying with the requirements of this Section and the installation requirements of the plans, by the following manufacturers are acceptable:

1. F&S Manufacturing Corp.
2. Fee and Mason Manufacturing Co.

PART 2 - PRODUCTS

2.1 HANGERS

- A. Hangers In Contact With Copper Piping: Shall be copper plated or teflon coated. Hangers shall be Fed. Spec. WW-H-171E, Type 9. Acceptable: Grinnell Fig. 97 or 97C, or equivalent.
- B. Hangers (other than in Contact with Copper Piping): Shall have manufacturer's standard finish. Hangers shall be of the following types:
1. Pipe 3" and Larger: Fed. Spec. WW-H-171E, Type 1. Acceptable: Grinnell Fig. 260 or equivalent.
 2. Pipe 2-1/2" and Smaller: Fed. Spec. WW-172E, Type 6. Acceptable: Grinnell Fig. 104 or equivalent.

2.2 ISOLATORS

- A. Refer to the Section, if included in this Division, which describes vibration isolation.

2.3 PIPE ROLLER STANDS

- A. Shall be Fed. Spec. WW-H-171D, Type 47. Acceptable: Grinnell Fig. 171, or equivalent.

2.4 PIPE ROLLER HANGERS

- A. Pipe Roller Hangers: Shall be Fed. Spec. WW-H-171E, Type 42. Acceptable: Grinnell Fig. 171, or equivalent.

2.5 PIPE ALIGNMENT GUIDES

- A. Acceptable: Grinnell Fig. 256, or equivalent.

2.6 PIPE RISER CLAMPS

- A. Pipe Riser Clamps: Shall be Fed. Spec. WW-H-171D, Type 8.

2.7 INSULATION SHIELDS

- A. Shall be Fed. Spec. WW-H-171D, Type 41. Acceptable: Grinnell Fig. 167, or equivalent.

2.8 BEAM CLAMPS

- A. Fed. Spec. WW-H-171D, Type 29. Acceptable: Grinnell Fig. 292 with links, or equivalent.

2.9 INSERTS

- A. Preset Type: Malleable iron with removable interchangeable nuts having lateral adjustment of not less than one and five-eighths inches. Continuous inserts shall have a capacity of 2,000 lb. per foot and shall be hooked over reinforcing. Acceptable: C-B Universal Fig. 282; Unistrut Products Co., P3200 or P3300; B-Line Systems, Inc., Series B- 32.1, or equivalent.

2.10 ROD

- A. Carbon steel, black threaded bolt ends or continuous thread, sized with safety factor of five (5). Acceptable: Grinnell Fig. 140 or 146, or equivalent.

PART 3 - EXECUTION

3.1 GENERAL

- A. Refer to Section entitled "General Mechanical Provisions". All inserts, fasteners, hangers and supports shall be installed in strict accordance with manufacturer's instructions.

3.2 PIPE

- A. General: Hangers shall be spaced to prevent sag and to permit proper drainage. All piping shall be run parallel with the lines of building, unless otherwise indicated on drawings. The hanger spacing and placement shall be such that after the covering (insulation and finish) is applied, there will be not less than 1/2" clear space between finished covering and other surfaces, including the finished covering of parallel adjacent pipes. Hangers for insulated pipes shall be sized to encompass the insulation, finish and metal insulation shield (a metal insulation shield shall be provided for each hanger or support). Vertical piping shall be supported with pipe riser clamps at every floor penetration, unless specifically indicated otherwise on the drawings. Hangers and supports shall not be placed at greater than the following intervals:
 - 1. Pipe 1-1/4" and Smaller: Six foot (6') centers and not more than two feet (2') from a change in direction (offsets, elbows, and tees).
 - 2. Pipe 1-1/2" through 2-1/2": Ten foot (10') centers and not more than two feet (2') from a change in direction (offsets, elbows and tees).
 - 3. Pipe 3" and Larger: Ten foot (10') centers and not more than two feet (2') from a change in direction (offsets, elbows, and tees).

3.3 EQUIPMENT

- A. Equipment supports shall be as otherwise indicated on the drawings or in the specifications.

3.4 DUCTWORK

- A. Refer to Sections describing ductwork.

3.5 POWDER (GUNPOWDER) ACTUATED FASTENERS

- A. Not allowed.

3.6 STEEL DECKING

- A. On projects where floor or roof slabs are installed over steel decking, drill or punch web of steel decking and insert hangers with washers before the concrete fill is poured in place. Hangers shall be plumb within one-half inch (1/2") in four feet (4') and spaced as required for service intended.

END OF SECTION 23 05 29

SECTION 23 05 35 - ELECTRIC MOTORS, HIGH EFFICIENCY TYPE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. This Section describes electric motors which are more efficient and have a generally better power factor than standard horizontal drip proof electric motors. These motors require less energy than standard electric motors which do not meet this specification.
- B. This specification covers horizontal, 3 phase, integral horsepower, drip proof, squirrel cage induction motors in the NEMA frame sizes through 449. This specification also covers single-phase electronic commutation motors specifically designed for fan applications.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division-23 and to all other applicable portions of the Drawings and Specifications.

1.4 STANDARDS

- A. All motors shall be in accordance with NEMA Standard MG1-1978, or the latest revision insofar as it is applicable. Motors shall also comply with the applicable portions of the National Electric Code.

PART 2 - PRODUCTS

2.1 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
- C. Sound Power Levels: Will be no greater than the guidelines as recommended by NEMA, MG 1-12.49. A motor which, in the opinion of the Architect, generates noise within the occupied area of the building, will be replaced with a quieter operating motor at no additional cost to the Owner.

2.2 POLY PHASE MOTORS

- A. Motors 1 horsepower and larger will be Premium Efficiency design, inverter duty rated and labeled for variable frequency operation.

2.3 VOLTAGE FREQUENCY

- A. Motors through 100 hp shall be rated 230/460 volts with 200 or 575 volts as optional; motors above 100 hp shall be rated 460 volts with 575 volts as optional. Motors will be rated for operation on a 3 phase, 60 Hertz power supply. Refer to Electrical Drawings.

2.4 COORDINATION

- A. Where variable frequency drives are used to vary the speed and power consumption of electric motors, such motors must be high efficiency type and must be considered with the actual variable frequency drives which are provided so that optimum matching of variable frequency drive to driven motor is obtained.

2.5 OPERATING CHARACTERISTICS

- A. Torques: Motors shall meet or exceed the locked rotor (starting) and minimum breakdown torques specified in NEMA standards for Design B for the ratings specified.
- B. Currents: Locked rotor (starting) currents shall not exceed NEMA Design B maximum values for the specified rating. Motors shall be capable of a 20 second stall at six times full load current without injurious heating to the motor components.
- C. Efficiency: Motors shall have a minimum and nominal full load efficiency which will meet or exceed the accepted values for industry standards for high efficiency motors when tested in accordance with NEMA test standard MG1-12.53a, IEEE Test Procedure 112, Method B, using accuracy improvement by segregated loss determination including stray load loss measurements. The minimum efficiency shall be guaranteed.
- D. Power Factor: The power factor for 3600 and 1800 rpm, 3 through 250 hp ratings at full load, at full voltage, shall be a minimum of 85%. Six-pole ratings will be excluded from this requirement.

2.6 SERVICE FACTOR AND AMBIENT

- A. Motors shall be rated for a 1.15 service factor in a 40°C ambient.

2.7 INSULATION

- A. Motors shall have a full Class B insulation system.
- B. Motors shall be dipped and baked in polyester varnish to consolidate the winding.

2.8 FRAME SIZE

- A. Horsepower/frame relationship shall conform to the latest NEMA Standard for T frame motors.

2.9 ENCLOSURE

- A. Motors shall be drip proof construction.
- B. Motor frame and endshields shall be of cast aluminum construction using alloys with low copper content.

2.10 BEARINGS

- A. All motors shall have anti-friction bearings, sized for a L-10 life of at least 125,000 hours L-10 life for a direct connected load.
- B. Aluminum endshields shall have a cast-in steel or cast iron bearing insert.
- C. Bearing housing shall be regreasable with provisions for purging old grease.

- D. Bearings shall be preloaded with a bearing loading spring to minimize noise and increase bearing life.

2.11 OTHER REQUIREMENTS

- A. Conduit Box shall be diagonally split and rotatable in 90 degree increments.
- B. External hardware shall be plated to resist corrosion.
- C. External paint shall withstand industrial environments.
- D. Nameplates shall be of stainless steel or aluminum and stamped per NEMA Standard MG1-10.37. Nameplate information shall include the nominal efficiency value per Standard MG1-12.53b and the manufacturer's minimum guaranteed efficiency value.

2.12 SHOP DRAWINGS

- A. In addition to shop drawing requirements of the section entitled, "General Mechanical Provisions", provide motor data including horsepower; rpm; frame size; nominal efficiency and nominal power factor at full load, 75% load and 50% load; guaranteed efficiency and guaranteed power factor at full load, 75% load and 50% load.

2.13 ELECTRONIC COMMUTATION (EC) MOTOR

- A. Motors shall be permanently lubricated with heavy-duty ball bearings to match the fan load and prewired to the specific voltage and phase. Internal motor circuitry shall convert AC power supplied to the fan to DC power to operate the motor. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted on the motor or by a 0-10 VDC signal as indicated on schedule. Motor shall be a minimum of 85% efficient at all speeds.

PART 3 - EXECUTION

3.1 MOTOR LOCATIONS

- A. Provide premium efficiency motors with sizes as indicated on schedules and plans.

END OF SECTION 23 05 35

SECTION 23 05 48 - VIBRATION ISOLATION EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. Provide vibration isolation supports for all equipment and piping as may be required to prevent transmission of vibration to building structure. This shall include air handling units, fans, piping, pumps and similar items.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division-23 and to all other applicable portions of the drawings and specifications.

1.4 SHOP DRAWINGS

- A. Refer to Section entitled "General Mechanical Provisions". Submittal data shall show type, point loading information, size and deflection of each isolator proposed and any other information as may be required for the Architect/Engineer to check isolator selections for compliance with specifications. Include clearly outlined procedures for installing and adjusting the isolators.

1.5 MANUFACTURERS

- A. Products of the following manufacturers will be acceptable, provided they comply with all of the requirements of this specification: Consolidated Kinetics; Mason Industries; Amber-Booth; Keflex; Flexonics; Vibration Eliminator Company or equivalent. Any model numbers listed are from one or more of these manufacturers and are given to provide an example of item(s) required.

1.6 OTHER REQUIREMENTS

- A. All vibration isolation equipment shall be both recommended by the manufacturer and approved by the Architect/Engineer for each particular application on this project.

PART 2 - PRODUCTS

2.1 BASIC REQUIREMENTS

- A. Unless otherwise noted, spring type vibration isolators shall be used for all motor driven equipment. It shall be the responsibility of isolation manufacturer to determine the amount of spring deflection required for each isolator to achieve optimum performance, prevent the transmission of objectionable vibration and meet noise criteria referenced herein.

2.2 CORROSION PROTECTION

- A. Steel components shall be phosphated and painted. All nuts, bolts and washers shall be zinc-electroplated. Structural steel bases shall be thoroughly cleaned of welded slag and primed with zinc-chromate or metal etching primer.

- B. All isolators exposed to weather shall have steel parts PVC coated or hot-dip galvanized. Aluminum components shall be etched and painted. Nuts, bolts and washers may be zinc-electroplated.

2.3 BASIC ISOLATORS

- A. General: Unit designations indicated are Architect/Engineer designations. Each of the following basic isolators may not be applicable to a specific installation application. See PART 3, "EXECUTION".
- B. Spring Mounts, Open Type, Unrestrained (Unit SMOU): Free standing springs; laterally stable; minimum horizontal-to-vertical spring rate (K_x/K_y) of 1.0: 1/2-inch neoprene acoustical friction pads between bottom baseplate and the supporting surface; leveling bolts; provision for bolting the mount to the equipment (unless otherwise specified); spring diameters not less than 0.8 of the compressed height of the spring at rated load; springs shall have a minimum additional travel to full compression of 50% of the rated deflection; 1-inch minimum static deflection (unless otherwise specified); submittals shall include spring diameters, deflections, free spring heights, solid spring heights and operating heights. Be similar to Mason Type SLF; Korfund Series L; Amber-Booth Type SW.
- C. Spring Mounts, Open Type, Restrained (Unit SMOR): Free standing springs; laterally stable; 1/2 inch neoprene acoustical friction pads between bottom baseplate and the supporting surface; leveling bolts; provision for bolting the mount to the equipment (unless otherwise specified); spring diameters not less than 0.8 of the compressed height of the spring at rated load; springs shall have a minimum additional travel to full compression of 50% of the rated deflection; 1-inch minimum static deflection (unless otherwise specified); restraint consisting of welded steel channel ends for outdoor installation and welded steel studs for indoor installation; restraint shall have restraining bolts connecting top plate and lower housing to limit vertical rise of isolated equipment when load is reduced; vertical clearance of 1/8 to 3/8 inch shall be maintained between spring top plate and housing (leveling bolts shall be adjusted to maintain this clearance). Submittal shall include spring diameters, deflections, free spring heights, solid spring heights and operating heights. Be similar to Mason Type SLR; Amber-Booth Type CT.
- D. Spring Mounts, Housed, Unrestrained (Unit SMHU): Springs free standing within their housing; laterally stable; 1/2 inch neoprene acoustical friction pads between bottom baseplate and the supporting surface; leveling bolts; provision for bolting the mount to the equipment (unless otherwise specified); spring diameters not less than 0.8 of the compressed height of the spring at rated load; springs shall have a minimum additional travel to full compression of 50% of the rated deflection; 1-inch minimum static deflection (unless otherwise specified); welded steel housing; vertical clearance of 1/8 to 3/8 inch shall be maintained between spring top plate and housing (leveling bolts shall be adjusted to maintain this clearance). Submittal shall include spring diameters, deflections, free spring heights, solid spring heights and operating heights. Be similar to Mason Type C.
- E. Neoprene and Spring Hangers, Vertical Deflection (Unit NSHV): Steel housing for undampened support of the spring: Provisions for attachment of hanger rods; reinforced neoprene washer and grommet to break up metal to metal contact; free standing spring; 1 inch minimum static deflection (unless otherwise specified) spring diameters not less than 0.8 of the compressed height of the spring at rated load; springs shall have a minimum additional travel to full compression of 50% of the rated deflection. Submittals shall include spring diameters, solid spring heights, free spring heights, deflections, overall hanger dimensions and maximum hanger rod diameter which can be accommodated by the hanger. Be similar to Mason Type DNHS; Amber-Booth Type BSR.
- F. Neoprene and Spring Hangers, Vertical and Angular Deflection (Unit NSHVA): Shall contain a laterally stable steel spring and 0.3" reflection neoprene or fiberglass element in series. A neoprene neck shall be provided where the hanger rod passes through the steel box supporting the isolator mount to prevent metal to metal contact. Spring diameters and hanger box lower hole sizes shall be large

enough to permit the hanger rod to swing through a 30 degree arc before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Mason Type 30N.

- G. Neoprene and Spring Hangers, Vertical Deflection, Position Type (Unit NSHVP): Steel housing for undampened support of the spring; provisions for attachment of hanger rods; reinforced neoprene washer and grommet to break up metal to metal contact; free standing spring; 1 inch minimum static deflection (unless otherwise specified); spring diameters not less than 0.8 of the compressed height of the spring at rated load; springs shall have a minimum additional travel to full compression of 50% of the rated deflection; be capable of holding the supported item at fixed elevation during installation with secondary adjustment to transfer the load to the spring while maintaining a fixed position; scale and pointer to indicate the deflection. Submittals shall include spring diameters, solid spring heights, free spring heights, deflections, overall hanger dimensions and maximum hanger rod diameter which can be accommodated by the hanger. Be similar to Mason Type PCDNHS: Amber-Booth Type PBS.
- H. Neoprene and Spring Hangers, Vertical and Angular Deflection, Position Type (Unit NSHVAP): Shall contain a laterally stable steel spring and 0.3" deflection neoprene or fiberglass element in series. A neoprene neck shall be provided where the hanger rod passes through the steel box supporting the isolator mount to prevent metal to metal contact. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30 degree arc before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Be capable of holding the supported item at the fixed elevation during installation with secondary adjustment to transfer the load to the spring while maintaining a fixed position; scale and pointer to indicate the deflection; similar to Mason Type PC30N.
- I. Neoprene-In-Shear Hangers (Unit NH): Steel housing for undampened support of the neoprene; provisions for attachment of hanger rods; neoprene-in-shear isolator; similar to Mason Type HD, Amber-Booth Type HRD.
- J. Neoprene-In-Shear Mounts (Unit NM): Double deflection neoprene-in-shear mountings shall have a minimum static deflection of 0.35". All metal surfaces shall be neoprene-covered. The top and bottom surfaces shall be neoprene ribbed and bolt holes shall be provided in the base. On equipment such as small vent sets and close coupled pumps, steel rails shall be used above the mountings to compensate for the overhang; steel rails shall be by same manufacturer as vibration isolators and equivalent to Mason Industries Type DNR. Mounts shall be Mason Industries Type ND, Consolidated Kinetics Type RD or Vibration Mounts and Controls Series RD.
- K. Flexible Pipe Connectors: Same internal diameter as the pipe in which the connector is installed (not necessarily internal diameters of inlets or outlets of equipment).
 - 1. Both recommended by the manufacturer and approved by the Architect/Engineer to be suitable for handling the conveyed fluid at all conditions (maximums and minimums of temperatures, pressures, velocities, etc.) encountered for each particular application.
 - 2. Of proper design to absorb the combination of vibratory and/or expansion or contraction motions (lateral and/or axial and/or angular) encountered at each installation point (for example, do not use hose type where axial motion is encountered at the installation point unless so recommended by the manufacturer and approved by the Architect.
 - 3. Stainless steel bellows type (Unit SSB): Heavy duty steel restraining rods and spacers; laminated steel bellows; steel flanges; permit axial, lateral and angular movement; rated to withstand 180°F operating temperature and 150 psig working pressure for chilled water; 250°F operating temperature and 150 psig working pressure for heating hot water; similar to Keflex Series 151 or 301.

4. Stainless steel hose type (Unit SSH): Rated to withstand 180°F operating temperature and 150 psig working pressure; have flanges except 2-1/2 inch and smaller sizes may have screw type fittings installed with a union at one end or with screw-on flanges at both ends; net flexible lengths shall be at least 6 pipe diameters for pipe up to 5 inch ID and not less than 36 inches for pipe 6 inch ID and greater; corrugated bellows with stainless steel wire braid restraining sheath; similar to Flexonics Type RW, RF or Series 400, Mason Type BSS, Keflex Series SSH.
- L. Acoustic Seals (Unit AS): Consist of an S-shaped molded synthetic rubber seal attached with stainless steel clamps to the pipe wall sleeves and to carrier piping. Wall sleeves shall be two pipe sizes larger than the carrier pipe and/or its insulation. Amber-Booth Type 301.
- M. Inertia Bases (Unit IB):
1. Weigh at least 1.5 times the weight of the particular machine being supported.
 2. Rectangular welded structural channel steel perimeter frame.
 3. Reinforced concrete.
 4. Height saving support brackets.
 5. Width and length at least 6 inches beyond machine's overall width and length (if necessary, larger for pumps as required to support suction and discharge wells).
 6. Structural steel channel depth and concrete base depth shall be a minimum of 1/15th of the longest base dimension but not less than 6 inches.
 7. Forms shall include 1/2 inch (or larger if necessary) steel reinforcing bars welded in place on 6 inch centers running both ways across the width and length in a layer 1-1/2 inches above the bottom of the base. Drilled steel members with sleeves welded below the holes to receive equipment anchor bolts.
 8. Similar to Mason Type KSL Base.
- N. Steel Equipment Frames (Unit SEF): Frames shall consist of structural steel sections sized, spaced and connected to form a rigid base which will not twist, rack, deform or deflect in any manner that will negatively affect the operation of the supported equipment or the performance of the vibration isolation mounts. Frames shall be of adequate size and plan form to support basic equipment units and motors plus any associated pipe elbow or duct elbow supports and electrical control elements or other components closely related and requiring resilient support in order to prevent vibration transfer from equipment to the building structure. Frames shall include side mounting brackets for attachment to Unit SMOU isolator or other specified isolator. The clearance between the underside of any frame or mounted equipment unit and the top of the building structure below shall be at least 2 inches.
- O. Neoprene Pads (Unit NP): Waffle or ribbed pattern neoprene pads shall be fabricated from 40-50 Durometer neoprene. Mason Type W.
- P. Captive Neoprene Mounts (Unit CNM): Double deflection neoprene-in-shear mountings shall have a minimum static deflection of 0.2". Ductile iron housing. Top screw. Minimum two (2) bottom anchor bolts. Mason Type BR.
- Q. Isolation rails, curb mounted, for roof mounted air handling units (Unit IRCM): Curb mounted roof top units shall each be isolated with a continuous roof top isolation assembly consisting of extruded aluminum rails formed to fit curb and equipment with a flexible air and weather seal continuously

joining the two rails and incorporating spring isolators sized for 1" static deflection. Flexible weather seals shall be 1/16th inch thick minimum reinforced Neoprene protected from direct sunlight and accidental puncture by an extruded aluminum shield and shall be capable of being replaced completely without disturbing the unit mounting. Springs shall be stable with a KX/KY (horizontal to vertical spring rate) of 1.0 or greater and be properly sized to support the load at 1" static deflection. Isolation assembly shall have Neoprene cushioned wind restraints which are not engaged in normal operation with sufficient capacity to resist wind load in any direction without distortion or damage to the isolated equipment. Entire assemblies shall be shipped in one piece to eliminate field joint and possible leakage. Mason Industries CMAB.

PART 3 - EXECUTION

3.1 GENERAL

- A. All isolators shall be installed in strict accordance with the manufacturer's instructions and shall be properly adjusted prior to requesting final inspection or the performance of any vibration testing specified.
- B. Each item of equipment (machinery, piping, etc.) which is provided with vibration isolation equipment shall rest in its intended, proper operating position (i.e. exactly level, etc.) after installation of vibration isolation equipment. Approval of such vibration isolation equipment by Architect/Engineer shall not relieve the Contractor of this responsibility.
- C. Equipment which is specified to rest on concrete housekeeping pads shall have Unit NP pads unless otherwise indicated.

3.2 PIPING IN AIR HANDLING UNIT EQUIPMENT ROOMS

A. General:

- 1. Isolators for equipment are described elsewhere in this specification; and it shall be the responsibility of the vibration isolation manufacturer to coordinate the selection of piping supports with equipment supports to provide for a carefully engineered system designed to accommodate expansion and contraction without creating excessive stress at any equipment connections or in any portion of the piping.
- 2. Hangers for horizontal piping shall be installed at regular intervals. Pipe risers shall be supported at the base of the riser. Submit hanger schedule.
- 3. The first three piping supports away from any given piece of vibrating equipment to which piping is connected shall be selected for an operating spring deflection not less than that specified for the equipment isolators. All other vibration isolation supports for horizontal piping shall have a minimum operating deflection of 3/4" with capability of 50% additional travel-to-solid. All supports for pipe risers shall have deflection capability at least four times the expansion or contraction to be accommodated.
- 4. Temporary anchors, where required, shall be installed to permit pre-adjustment of springs in risers. Pre-adjustment procedure, which is intended to control direction of pipe movement and final operating deflection of the springs, shall be detailed in submittal data.
- 5. Permanent limit stops shall be installed to prevent excessive vertical motion of risers in the event water is drained from system. Locations and other details of these limit stops shall be submitted to Architect/Engineer for acceptance.

6. Piping connected to vibration isolated equipment shall be installed so that it does not strain or force out of alignment vibration isolators supporting the basic equipment, nor shall pipes restrict such equipment from "floating" freely on its respective vibration isolation system.
7. Drain piping connected to vibrating equipment shall not physically contact any building construction or non-isolated systems or components.
8. Do not allow the weight of the pipe to be carried by walls through which the pipe passes.

B. Isolator Locations:

1. Ceiling hung piping to air handling units: Provide neoprene and spring hangers, vertical and angular deflection (Unit NSHVA) at the first three support points of pipe runs connected to the vibrating equipment or at all support points along the first 50 feet of pipe runs connected to the vibrating equipment, whichever length is greater, but not to exceed length of mechanical equipment room.
2. Floor supported piping to air handling units: Provide resilient support for floor supported piping same locations as specified above for ceiling hung piping. Provide open type unrestrained spring mounts (Unit SMOU) for first three support points; use neoprene-in-shear mounts (Unit NM) thereafter and both with supplemental supports as required by job conditions.
3. Acoustic Seals: Provide acoustic seals (Unit AS) at all wall, ceiling and floor openings through which pipe runs from equipment rooms into adjoining spaces.

3.3 PIPING IN MAIN CENTRAL MECHANICAL EQUIPMENT ROOM

A. General: The requirements of the paragraph entitled "General", in the above article entitled "Piping in Air Handling Unit Equipment Rooms" shall also apply. Also, the following is applicable:

1. In order to be certain that the piping weight is properly distributed and not distorting the machine flanges, the first four hangers from each machine connection shall be position hangers.

B. Type and Extent of Piping to Isolated:

1. All piping connected to any kind of pump, pump assembly, chiller, air compressor assembly, air handling unit, boiler, or other type of vibrating equipment shall be isolated as follows. This includes (but is not necessarily limited to) piping conveying chilled water, condenser water, condensate, domestic water, fire protection water, make-up water heating hot water, steam, and compressed air.
2. This spring isolation shall be continuous throughout the piping systems of the main central mechanical equipment room.

C. Basic Isolator Types:

1. Floor Supported Piping: Unit SMOU, SMOR or SMHU, as applicable.

2. Piping Suspended from Above: Units NSHVA or NSHVAP, as applicable.
3. Static Deflection: As recommended by the vibration isolation manufacturer as dependent upon size, length and weight of applicable piping and its conveyed fluid.
4. Acoustic Seals: Provide acoustic seals (Unit AS) at all wall, ceiling/floor openings through which pipe runs into adjoining spaces.

3.4 AIR HANDLING UNITS, FACTORY PACKAGED

A. Floor Mounted:

1. Spring mounted fan and motor (Unit SMOU) with 1 inch minimum static deflection when AHU motor is 5 hp. or less; spring mounts with 2 inch minimum static deflection when AHU motor is 7-1/2 hp. or greater. Instead of bolting the units to the spring mounts, provide height saving brackets.
2. Flexible duct connections as specified in "Duct System Accessories" section.
3. Flexible pipe connectors (Unit SSB).
4. Steel equipment frame (Unit SEF) manufacturer's standard unit frame or base is not sufficiently stiff and rigid to permit point vibration isolation.
5. Mount equipment on neoprene pads (Unit NP) on reinforced concrete housekeeping pad as specified in other sections.

B. Suspended from Building Structure:

1. Spring hangers (Unit NSHV) with 1-inch minimum static deflection when motor is 5-HP or less; spring hangers (Unit NSHV) with 2-inch minimum static deflection when motor is 7-1/2 HP or greater.
2. Flexible duct connectors as specified in Section entitled "Ductwork".

3.5 FAN COIL UNITS AND FANS, IN-LINE CENTRIFUGAL LIGHT DUTY AND HEAVY DUTY

- A. Flexible duct connectors as specified in "Ductwork".
- B. Neoprene-in-shear hangers (Unit NH).
- C. Piping (first 10 feet) with neoprene hangers (Unit NH).

3.6 FANS, IN-LINE CENTRIFUGAL HEAVY DUTY

A. Suspended from Structure:

1. Spring hangers (Unit NSHV) with 1-inch minimum static deflection when motor is 5 HP or less; spring hangers (Unit NSHV) with 2-inch minimum static deflection when motor is 7-1/2 HP or greater.
2. Flexible duct connectors as specified in Section entitled "Ductwork".

3.7 FAN INDUCTION TERMINAL UNITS

- A. Flexible duct connectors as specified in "Ductwork".
- B. Neoprene-in-shear hangers (Unit NH).
- 3.8 PUMPS, HORIZONTAL BASE MOUNTED
 - A. Inertia bases (Unit IB).
 - B. Spring mounts (Unit SMOU or SMOR as applicable) with 2-inch deflection.
 - C. Flexible pipe connectors (Unit SSB).
- 3.9 CHILLERS, CENTRIFUGAL
 - A. Mount on neoprene pads (Unit NP) on concrete housekeeping pad.
 - B. Flexible pipe connectors (Unit SSB) at CHW and CW connections.
- 3.10 CHILLERS, AIR COOLED
 - A. Mount on captive neoprene mounts (Unit CNM) on concrete housekeeping pad.
 - B. Flexible pipe connectors (Unit SSB) at CHW and CW connections.
- 3.11 BOILERS
 - A. Mount on neoprene pads (Unit NP) on concrete housekeeping pad.
- 3.12 TEMPERATURE CONTROL AIR COMPRESSOR
 - A. Spring mounts (Unit SMOU) with 1.0 inch deflection.
 - B. Flexible pipe connectors (Unit SSH).
- 3.13 MANUFACTURER'S SUPERVISION
 - A. The Contractor shall include in his price the cost of the vibration isolation manufacturer or his qualified representative for providing such supervision as may be necessary to assure correct installation and adjustment of the isolators. Upon completion of the installation and after system is put into operation, the manufacturer or his representative shall make a final inspection and submit his report to the Architect/Engineer in writing certifying the correctness of installation and compliance with approved submittal data.

END OF SECTION 23 05 48

SECTION 23 05 53 - IDENTIFICATION OF HVAC SYSTEMS AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. Provide complete identification of the mechanical systems including ductwork, piping, valves and equipment as noted herein.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Divisions 21, 22 and 23 and to all other applicable portions of the Drawings and Specifications.
- B. This section directly relates in particular to sections (which may or may not be included in this division) which describe the following:
 - 1. Piping and the interconnected equipment and component items for the following systems:
 - a. Chilled water.
 - b. Hot water.
 - c. Steam.
 - d. Compressed air.
 - e. Insulation.

1.4 APPLICABLE PIPING AND RELATED ITEMS

- A. Piping and interconnected equipment and component items for the following systems shall be identified. Identification of the following systems shall not preclude the identification of other systems where identification of such other systems may be specified in other sections. Systems requiring identification as work of this section are:
 - 1. Chilled water.
 - 2. Hot water.
 - 3. Steam.

1.5 SHOP DRAWINGS

- A. Refer to Section entitled "General Mechanical Provisions". Provide schedule of colors, lettering, tagging, handling and similar items to clearly identify proposed method of identification for mechanical systems.

1.6 DIMENSIONS

- A. Pipe dimensions as used in this section refer to the total outside dimensions (diameters) of both the pipe and its insulation (if any).

PART 2 - PRODUCTS

2.1 GENERAL

- A. Comply with ANSI A13. 1-2015, "Scheme for Identification of Piping Systems" and OSHA requirements, or as otherwise indicated.
- B. Acceptable Manufacturers: W. H. Brady Co., 2223 West Camden Road, Milwaukee, WI 53201; Seton Name Plate Corporation, 592 Boulevard, New Haven, CT 06505, or equivalent.

2.2 MARKERS, BANDS, TAGS, STENCILS, AND LABELS

- A. Markers: Must have approved color coded background, proper color of legend in relation to background color, approved legend letter size, approved length and flow arrow indicator.
 - 1. Pipes 3/4" through 5" O.D.: Seton "Setmark" Type SNA marker or equivalent.
 - 2. Pipes 6" O.D. and Greater: Seton "Setmark" Type STR marker or equivalent.
- B. Bands: Color coded in minimum widths of 2-1/4" for pipe through 12" O.D. and 4" for pipe 14" O.D. and greater. Brady B-500 Vinyl Cloth, B-350 PermaCode or B-946 Outdoor Film or equivalent as applicable.
- C. Valve Tags: Each tag shall designate appropriate service and valve number. Be securely attached with meter seals with 4-ply 0.018 copper smooth wire, or brass "S" hooks, or brass jack chain in a manner to allow easy reading. Provide either of the following types:
 - 1. Brass Type: Minimum 19 gauge polished brass; 1-1/2" min. diameter. Acceptable: Seton Style 250-BL or equivalent.
 - 2. Aluminum Color Coded Type: Anodized aluminum; 2": min. diameter. Acceptable: Seton Style 2070 or equivalent.
 - 3. Aluminum Alloy Type: 16 gauge sheet aluminum: depressed type letters filled with black enamel. Face and periphery of satin finish Alumilite, Alcoa 204A2 or equal, free from burns and scratches. Seton Type 4 or equivalent.
 - 4. Fiber Glass Type: 1/16" thick glass fiber reinforced resin. 2" x 2" size of 2-1/2" x 9" size as necessary to identify item. Brady Series No. 2297 or equivalent.
- D. Stencils: Prepared with minimum letter height of 4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door labels and similar operational instructions.
 - 1. Stencil Material: Aluminum, Brass, Fiberboard or metal.
 - 2. Stencil Paint: Exterior, gloss, alkyd enamel or acrylic enamel (as appropriate for the material being painted), black unless otherwise indicated. Paint may be in pressurized spray-can form.
- E. 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" min. thickness. Sized 3/4 x 2-1/2, 1 x 2-1/2, 1 x 3 or 1-1/2 x 4 as necessary to identify item. Seton "Setonite" or equivalent.
2. Aluminum Type: Engraved, flexible, 0.020" thick aluminum. Sized 3/4 x 2-1/2, 1 x 3, 1-1/2 x 4 or 3/6 as necessary to identify item. Seton No. 06505 or equivalent.

PART 3 - EXECUTION

3.1 GENERAL

- A. Apply only after completion of insulation, painting and cleaning work so that final identification is not disfigured by such other work.
- B. Coordinate with actual composition and operating temperatures of surface on which identification is to be placed so that proper permanent adhesion of markers and labels to surface is obtained.
- C. Locate marking and banding where practical such that groups of pipe are identified at similar location for ease of visual tracking. For example, mark and band parallel runs of pipe which are side-by-side at the same general place.
- D. Small pipes less than 3/4" diameter may be identified with tags similar to those specified for valves.
- E. Adhere or affix all identification items permanently except where removal may be necessary for maintenance or service.

3.2 MARKERS AND BANDS

- A. Provide on piping as follows:
 1. Pipe Concealed in Inaccessible Locations (e.g., Chases, Underground): No identification required.
 2. Pipe Concealed in Accessible Locations (e.g., Ceiling Plenums):
 - a. Markers every 30 feet of pipe length. Bands every 15 feet of pipe length.
 3. Pipe Exposed in Equipment Rooms:
 - a. Markers every 15 feet of pipe length for pipe through 12 inches O.D. and every 30 feet for pipe 14 inches O.D. and greater.
 4. Bands every 10' of pipe length for pipe through 12" O.D. and every 25' for pipe 14" O.D. and greater.
 5. Exterior Pipe, Exposed: No identification required unless otherwise indicated.

3.3 VALVE TAGS

- A. Valve tags shall be installed on the following items:
 1. All motorized 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. All manual valves which perform functions other than isolation of an equipment item for servicing. This includes, but is not limited to, valves in valve stations, remote locations where use is not evident due to proximity of equipment or other piping, and similar locations.
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.

3.4 VALVE TAG LISTS

- A. Prior to substantial completion, provide a complete list of all valves having tags. Indicate the following on such list:
 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.

3.5 DUCT LABELS

- A. Stenciled Duct Label: Provide stenciled labels identifying duct system service (OUTSIDE AIR, RETURN AIR, SUPPLY AIR, EXHAUST AIR, RELIEF AIR) and stenciled flow direction arrows.
- B. Locate labels in mechanical rooms and near points where ducts enter concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.6 LABELS

- A. 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, , starters, variable frequency drives, control panels, terminal units, flow stations, reheat coils and similar items.
- B. Provide labels on access panels and ceiling grids to advise of item that are accessible through the panel or ceiling tile.

3.7 COLORS

- A. Colors for piping systems and equipment which are required to be painted shall be as follows for those systems which may be applicable to this project:
 1. Domestic Cold Water: Medium green enamel with domestic cold water legend.
 2. Domestic Hot Water and Domestic Hot Water Recirculation: White insulation with yellow tape or metal bands with domestic hot water (domestic hot water recirculation) legend.
 3. Chilled Water Piping: Blue mastic with blue tape or bands with chilled water supply (or return) legend.

4. Heating Hot Water Piping: Burnt orange with heating hot water supply (or return) legend.
 5. Gas Piping: Yellow with gas legend.
 6. Compressed Air Piping: Light grey with compressed air legend.
 7. Fire Protection Piping: Red with fire line legend.
 8. Sprinkler Piping: Red with sprinkler legend.
 9. Condenser Water Piping: Tan with condenser water supply (or return) legend.
 10. Roof Drainage Piping: Light green with storm water legend.
 11. Compressed Air Piping: Black with compressed air legend.
 12. Natural or L.P. Gas Piping: Yellow with gas legend.
 13. High (or Medium or Low) Pressure Steam Supply Piping: White insulation jacket or aluminum jacket with yellow tape or bands with HP (MP, L.P.) steam legend.
 14. High (or Medium or Low) Pressure Steam Condensate Piping: White insulation or aluminum jacket with yellow tape or bands with HP (MP, LP) steam legend.
 15. Equipment Hot Vent Piping (Below 100°F): Light brown with vent legend.
 16. Equipment Hot Vent Piping (Above 100°F): Light brown tape or bands over insulation or metal jacket with vent legend.
 17. Vacuum (Housekeeping): Light olive green with vacuum legend.
 18. Fuel Oil (Supply, Return, Vent) Piping: Yellow with fuel oil legend.
 19. Generator Exhaust Piping:
 - a. Insulated: White insulation with yellow tape or band with generator exhaust legend.
 - b. Bare Pipe and Fittings: Silver (suitable for extra high temperature application).
 20. Sanitary Sewer and Vent Piping: Brown with sanitary sewer (vent) legend.
 21. Electrical conduit (not specified as painted in other divisions of these specifications): Silver.
- B. Identification: Coordinate colors and finishes with pipe identification.

END OF SECTION 23 05 53

SECTION 23 05 93 - PERFORMANCE VERIFICATION, PRELIMINARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawing and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. Put all work in a state of readiness for final performance verification.
- B. Final performance verification shall not begin until the systems are complete and operable in all respects and all related building systems are complete.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 23 and to all other applicable portions of the Drawings and Specifications.
- B. Refer to the section which describes "Performance Verification, Final".

PART 2 - PRODUCTS

This section not applicable.

PART 3 - EXECUTION

3.1 WATER SYSTEMS

- A. Prepare each water system for balancing in the following manner:
 - 1. Open all valves to the full position, including coil stop valves; close bypass valves, and open return line balancing cocks.
 - 2. Clean all strainers.
 - 3. Examine fluid in each system to determine that it has been treated and is clean.
 - 4. Check pumps for proper rotation.
- B. Check expansion tanks for full capacity of water and the absence of air lock.
- C. Check all air vents at high points of system for proper installation and free operation. Remove all air from circulating system.
 - 1. Set all temperature controls for full heat or full cooling (as applicable) from all coils.
 - 2. Check for proper operation of any automatic bypass valves.

3.2 STEAM SYSTEMS

A. Prepare steam systems for balancing in the following manner:

1. Open all valves to the full position in a gradual and modulated manner as appropriate for steam system start-up.
2. Clean all strainers, traps and control valves.
3. Examine system to determine that it has been treated and is clean.
4. Check condensate return system pumps for proper rotation.
5. Check tanks, heat exchangers and other vessels for full capacity of water and the absence of air lock.
6. Check all air vents for proper installation for free operation.
7. Remove all air from circulating system.
8. Set all temperature controls for full heat.
9. Check for proper operation of any automatic valves.

3.3 AIR SYSTEMS

A. Prepare the air side for balancing in the following manner:

1. All fans, blowers, and air handling equipment shall be mechanically checked and available to operate under design conditions.
2. All splitters, volume dampers, fire dampers, and vanes shall be in their neutral positions.
3. All grilles, diffusers, and like items, shall be installed with dampers, vanes, and blades in their neutral positions.
4. All controls, whether they are electronic, electric or pneumatic or a combination thereof, shall be mechanically checked and ready to operate under design code in an operable and non-overloading condition.

3.4 ADDITIONAL REQUIREMENTS

- A. Complete Installation: The Contractor shall complete the equipment and system installation to the satisfaction of the Architect/Engineer (who will be the sole judge of its state of readiness) prior to advising, the writing, that final performance verification is ready to begin. The Contractor is hereby advised that the Certificate of Substantial Completion will not be issued prior to the completion of final performance verification work and that he should therefore, schedule all other work accordingly allowing no less than 60 days for completion of final performance verification.
- B. Clean, Flush and Fill Systems: The Contractor shall include the cleaning, flushing, filling, and venting of all hydronic and steam systems; the setup, check-out, and startup of chemical treatment systems; and the setup, checkout and startup of all equipment as work to be complete prior to the start of final performance verification.
- C. Correction of Defects: The Contractor shall promptly and properly correct all defects in workmanship, material, installation and equipment of which he is aware prior to requesting that final performance

verification work begin. Once the final performance verification work has begun, the Contractor shall promptly correct all defects in workmanship, materials, installation, and equipment as they are called to his attention by Architect/Engineer.

- D. Drive Changes or Impeller Change or Trim: Changes in pulleys and/or belts and impeller replacement or trimming required for correct final balance during testing shall be made at no additional cost.
- E. Scheduling and Coordination: The Contractor shall be responsible for proper scheduling and coordination of work involved in preliminary performance verification. This shall include, but is not necessarily limited to the timely provision of: mechanics, tools, equipment, correction of defects, equipment manufacturer's representatives, test modules, and all other items which may be required.
- F. Report: Submit a written report describing and certifying in detail all preliminary performance verification items and tasks that have been performed. Approval of this report by the Architect/Engineer will precede final performance verification.

END OF SECTION 23 05 93

SECTION 23 05 94 - PERFORMANCE VERIFICATION, FINAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. Provide the services of an independent test and balance agency to verify the performance of the complete heating, ventilating and air conditioning systems as described by Division 23. Performance verification shall be accomplished by established testing and balancing procedures as described in this section.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 23 and to all other applicable portions of the Drawings and Specifications.

1.4 TEST AND BALANCE AGENCY

- A. All performance verification shall be performed by an independent test and balance agency (herein referred to as the "T & B Agency") which is fully certified by and a current member of the Associated Air Balance Council (AABC).

1.5 CONTRACTUAL RELATIONSHIP

- A. Performance verification shall be performed as a service of the T & B Agency directly to the Construction Manager or Owner with no other subcontractors as part of the agreement.
- B. Performance verification is specified in this Division 23 only because it relates predominantly to Division 23 work. However, the inclusion in this Division 23 of this section covering performance verification shall not preclude the contractual agreement of the T & B Agency from contracting directly to the Construction Manager with no other subcontractors as part of such agreement.

1.6 AGENCY APPROVAL

- A. Submit the name and qualifications of the proposed T & B Agency to the Architect/Engineer for approval within thirty (30) days of Notice to Proceed.
- B. Include AABC National Project Certification Performance Guaranty.

1.7 WORK INCLUDED

- A. The T & B Agency shall provide all labor, supervision, professional services, tools, test equipment and instruments (except as otherwise specified) to perform the following work and all other work of this section:

1. Review the automatic temperature control and air terminal unit specifications for their respective and combined effects on the testing and balancing procedures for the air and hydronic systems.
2. Where in the opinion of the T & B Agency conditions may exist in the system design or construction that may have the potential of adversely affecting system performance, then the T & B Agency shall identify the condition and submit in writing recommended correctives for consideration by the Architect/Engineer.
3. During construction, review those shop drawings which have relevance 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 to be accomplished.
4. Perform site inspections to verify compliance with documents, and observe pressure tests on ductwork.
5. Perform a complete air and hydronic test and balance of all heating, ventilating, air conditioning and exhaust air systems and all water and steam systems shown and described on the Construction Documents and as further described herein.
6. Submit Equipment Test and Systems Balance Report.
7. Furnish specifications to Contractor for properly sized fixed sheaves on fan systems after proper RPM has been established.

1.8 EXISTING SYSTEMS

- A. Prior to balancing and testing the new systems, obtain test data on those existing systems which may be affected by the new work. Then, after the new work is provided, rebalance (if and as necessary) those existing systems so that they operate at the same conditions under which they were operating prior to the new work.
- B. The above test data shall be provided as part of the test and balance report. The test data shall include the water and air flow rates and temperatures entering and leaving any equipment items which are part of the existing heating, ventilating and air conditioning system. However, only the fluid affected by the new work need be tested (for example, an air handling unit which is unaffected on its airside but which is affected on its waterside need only have water data obtained). Also, if a piping system branch serves a group of units, then only the flow at the existing branch need be measured and not necessarily the flow at each air handling unit served by the branch (unless measurement at each unit is the only way to obtain the branch total flow).

1.9 GUARANTY

- A. The T & B Agency shall include a warranty period of ninety (90) days after completion and acceptance of test and balance work. During the warranty period, the Architect/Engineer 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 Architect/Engineer in conducting any test that he may require during this time. The foregoing shall be in addition to the A.A.B.C. National Project Certification Performance Guaranty which shall also be provided.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The tangible product of this section shall include the reports and documentation necessary to verify the systems' performance.

2.2 REPORT

- A. The T & B Agency shall in the course of his work record the information herein specified. Recorded test data shall be at the final balanced condition for each system. Recorded data shall be arranged by system using the appropriate designation as established on the Construction Documents. Four (4) copies of the final report signed, bound and indexed shall be submitted to the Architect/Engineer for his approval or comments.
- B. Where actual measurements recorded for the final balance show deviations of more than 10% from the design, the T & B Agency shall note same in the report and submit recommendations for corrective action to the Architect/Engineer for his consideration.
- C. In those cases where recorded data can be reasonably interpreted to be inaccurate, inconsistent and/or erroneous, the Architect/Engineer may request additional testing and balancing. The T & B Agency shall at no additional cost perform such retesting and rebalancing as directed by and in the presence of the Architect/Engineer.
- D. 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 action to the Architect/Engineer.
- E. The T & B Agency shall verify that each thermostat and the devices it is controlling, such as control valves, motorized dampers, VAV boxes, etc., operate in the exact sequence required.
- F. Test Data: Include the following data in the Systems Test and Balance Report:
 - 1. Motors:
 - Manufacturer
 - Model and serial number
 - Rated amperage and voltage
 - Rated horsepower
 - Rated RPM
 - Corrected full load amperage
 - Measured amperage and voltage
 - Calculated BHP
 - Measured RPM
 - Sheave size, type and manufacturer
 - 2. Fans:
 - Manufacturer
 - Model or Serial number, BI or Air Foil - number of blades
 - Rated CFM, measured CFM
 - Rated RPM, measured RPM
 - Measured pressures - Inlet and Outlet Static Pressure
 - Pulley size, type and manufacturer
 - Belt size and quantity
 - Rated TSP
 - Operating TSP & operating ESP (at discharge side of

Supply Fan or suction side of Exhaust/Return Fan)
For AHUs: Full static pressure profile of each component.

3. Pumps:

Manufacturer
Model or Serial number, impeller size
Rated RPM, measured RPM
Rated head, measured head
Rated pressures
Measured discharge pressure (full flow and no flow)
Measured suction pressure (full flow and no flow)
Measured GPM
Operating head
Operating RPM

4. Air Systems (including inlets and outlets):

Provide single line diagrammatic plan locating each air inlet and outlet and its reference number.
Grille or diffuser reference number and manufacturer.
Grille or diffuser location.
Design velocity.
Design CFM.
Effective area factor and size.
Measured velocity.
Measured CFM
Terminal Unit CFM

5. Steam Boilers:

Manufacturer
Model and Serial number
Entering water temperature
Entering water flow
Leaving Steam pressure
Leaving Steam temperature
Leaving Steam flow

G. Other Report Requirements: Where any systems have equipment or components which are not covered by the above, then the Final Test and Balance Report shall include the following data as applicable to such equipment or systems to confirm actual operation:

1. All inlet and outlet areas.
2. All applicable duct, pipe and coil sizes.
3. Outside, inside, mixed and supply air conditions.
4. All fluid velocities, flow rates, temperatures and pressures at appropriate locations.
5. All speeds.
6. All voltage and ampere ranges.

7. Descriptions of each test method used.

2.3 INSTRUMENTATION

- A. All test and balance equipment and instruments to be furnished by the T & B Agency shall have been calibrated within six (6) months of use on this work. A list of equipment and instruments to be used shall be submitted to the Architect/Engineer prior to commencing test and balancing operations and shall include equipment and/or instruments, name, manufacturer, serial number and certification of last calibration date. Instruments without calibration adjustment capability shall be accompanied with manufacturer's certification of accuracy. Test and balance equipment and instruments furnished by the Contractor to the T & B Agency shall be accompanied with certification as required above. The T & B Agency shall be responsible for the protection from damage due to accident, abuse or misuse, all equipment and instruments provided by the Contractor, and shall return same in good working condition at the completion of the test and balance work to the Contractor. The T & B Agency shall repair at his expense to original condition and accuracy or replace with like equipment and instruments damaged in the work.

2.4 DIAGRAMS

- A. Provide a schematic diagram (i.e., one-line) of duct system(s) tested. Indicate on the diagram the relative location of all air distribution devices, VAV boxes, heating/cooling coils, points of data measurements (i.e., pitot traverse, temperature, static pressure) fans, air handling units, and similar equipment included in the system. Diagram shall identify each component tested. Said identification shall utilize the conventions shown on the drawings (i.e., AHU-1 or SF-6) and correlate with the data sheets provided in the Test and Balance Report.

2.5 LOGS AND FORMS

- A. Logs and forms shall clearly indicate following:
1. All inlet and outlet areas.
 2. All applicable duct, pipe and coil sizes.
 3. Outside, inside, mixed and supply air conditions.
 4. All fluid velocities, flow rates, temperatures and pressures at significant locations (e.g., fluid pressures before and after each pump and fan, temperatures and pressures at supply and return headers and at chiller and boiler inlets and outlets, etc.).
 5. All fan speeds.
 6. All motor ampere ranges.
 7. Descriptions of each test method used.
- B. Associated Air Balance Council log and data forms.

PART 3 - EXECUTION

3.1 GENERAL

- A. Sheaves: The Contractor shall provide applicable fans with V-belt drives and fixed pitch sheaves. In order to provide the properly sized fixed pitch sheave, the Contractor shall initially provide fans with

V-belt drives, variable pitch sheaves. The Contractor, upon completion of system balancing by the T & B Agency, will replace these adjustable pitch sheaves with fixed sheaves of the size and type specified by the T & B Agency. The Contractor shall tag the adjustable sheaves, transmit same to Owner, and receive written receipt by Owner of acceptance of these sheaves.

- B. Load Conditions: All testing and balancing of systems shall be undertaken with maximum attainable load. Testing and balancing of all air handling systems shall be accomplished with ceiling tile in place and enclosing partitions and doors erected.
- C. Observe all equipment and exposed piping for noise, movement or vibrations under normal operating conditions and report excesses to the Architect and Owner.
- D. Where patented measuring stations are installed, each of these is to be read and recorded. In the hydronic systems, the permanent devices, such as flow tubes with mercury manometers, annular ring systems, venturi tubes with portable meters, etc. must be used for final measurements after they are completed, calibrated and in satisfactory condition.

3.2 PERFORMANCE VERIFICATION, PRELIMINARY

- A. The Contractor, prior to commencement of the balancing by the T & B Agency, shall verify in writing:
 - 1. That strainers have been removed and cleaned.
 - 2. That all air filters have been installed and are in clean condition.
 - 3. That expansion tanks have been inspected and that the system is not air bound and is completely filled with water.
 - 4. That all air vents at coils and high points of the piping systems have been inspected and are installed and operating freely.
 - 5. That all automatic valves, hand valves, and balancing valves have been left or fixed in the open position for full flow through all devices.
 - 6. That all linkages between valves or dampers and their actuators are secure.
 - 7. That all pumps and fans are operating at the specified RPM.
- B. The Contractor shall confirm in writing that the systems as scheduled for balancing, are operational and complete and that all piping and ductwork have been pressure tested and accepted and all affected piping systems have been cleaned, flushed and refilled with prescribed treated water and vented.

3.3 PROTECTION OF WORK

- A. The Contractor shall protect all mechanical devices during the testing and balancing period. The activities of the T & B Agency will include but not be limited to the adjustments of designated balancing devices including; adjustment of balancing dampers, adjustment of inlet vane dampers, adjustment of air extractors, air splitters, or manual dampers, the adjustment of adjustable sheaves for fan speed, the adjustment of balancing valves, or similar devices. The existence of the T & B Agency shall not relieve the Contractor of his responsibility for the complete operation of the mechanical systems in conformance with the contract documents.

3.4 CORRECTION OF WORK

- A. The Contractor shall at no additional cost to the Owner rectify discrepancies between the actual installation and contract documents when in the opinion of the T & B Agency the discrepancy will significantly affect system balance and performance.

3.5 COORDINATION AND ASSISTANCE

- A. The Contractor shall assist the T & B Agency by providing all labor, equipment, tools and material required to operate all of the equipment and systems necessary for the testing and balancing of the systems and for the adjustment, calibration or repair of all electric or pneumatic or automated control devices and components. These services shall be available on each working day during the period of final testing and balancing. The Contractor shall assist the T & B Agency by arranging to have all ceilings, partitions, windows, and doors installed prior to the scheduled commencement of balancing within each specified area.
- B. The Contractor shall provide to the approved T & B Agency a complete set of plans and specifications and an approved copy of all heating, ventilating and air conditioning equipment shop drawings. The Contractor shall include the cost of all pulley, belt, and drive changes, as well as balancing dampers required to achieve proper system balance recommended by the T & B Agency.

3.6 AIR SYSTEMS

- A. 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.
 - 2. Make pitot tube traverse of main supply ducts to verify design cfm. Seal duct access holes with rubber or metal snap-in plugs.
 - 3. For each supply air system, verify the quantity of outside air and return air when the system is operating in the maximum cooling and full heating modes.
 - 4. Test and adjust each diffuser, grille and register to within 10% of design requirements, and also adjust so as to minimize drafts in all areas.
 - 5. Observe all equipment and exposed ductwork for noise, movement or vibration under normal operating conditions and report excesses to the Architect/Engineer.
- B. After all air distribution devices have been balanced to distribute calculated design indicated air quantities and if temperature in any area (where such area does not have the particular zone temperature control thermostat located therein) of any zone is not maintained within 2 degrees plus or minus of the zone areas which does have the zone temperature control thermostat, then notify Architect/Engineer of such conditions and obtain approval to rebalance devices to obtain air quantities other than those indicated so that air temperature in entire zone will be as even as possible regardless of calculated design air quantities. After obtaining approval to rebalance, perform such necessary rebalancing.

3.7 HYDRONIC AND STEAM SYSTEMS

- A. The testing and balancing shall include, but is not necessarily limited to, the following requirements as applicable to either or both the hydronic systems and steam systems:
 - 1. Prior to testing and balancing of each system check all flow meters for proper installation, calibration and accuracy.
 - 2. Measure and adjust pump flow capacity to proper quantity.

3. Adjust flow through chillers.
4. Adjust flow through any heat exchangers.
5. Balance system flows.
6. Coordinate equipment operation and output performance with the manufacturer's representative. Record inlet and outlet temperatures.
7. Mark or otherwise record settings of adjustable balancing devices which provide the design flow requirement.
8. For each hydronic system record flow rate, pump inlet and outlet pressures and motor amperage for each pump for each increment of system flow rate provided by the pumping/piping configuration. Variable speed pumps shall operate as constant volume pumps at maximum speed for purposes of this record.

END OF SECTION 23 05 94

SECTION 23 07 00 - INSULATION, HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. Provide all work necessary to insulate all equipment, piping, ducts and other items related to the piping and duct systems.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division-23 and to all other applicable portions of the Drawings and Specifications.
- B. This section directly relates in particular to sections (which may or may not be included in this division) which describe the following:
 - 1. Piping systems.
 - 2. Duct systems.
 - 3. Heat generating equipment.
 - 4. Heat exchange equipment.
 - 5. Cooling equipment.
- C. Vessels, tanks, stacks, and other items which contain or convey fluids which are at such temperatures as to create condensation or surface temperatures which are hazardous or where heat loss or gain prohibits proper system operation.

1.4 SHOP DRAWINGS

- A. General: Refer to the Section entitled "General Mechanical Provisions". Shop drawings shall contain complete descriptive and engineering data, including flame spread and smoke developed ratings (ASTM E84 test method) on all materials and adhesives. Where finishes, covers, or jackets are specified, provide complete data on same. Shop drawings shall contain specified information on: densities, conductivities, conductances, or resistances as required to establish conformance with the specified values or materials.
- B. Shop drawings shall include a schedule or narrative indicating for each pipe and duct system or equipment the insulation type, thickness, jacket, and adhesive to be used. Include fastening and installation details.
- C. Industry Standards: Where compliance with an industry, society or association standard is specified or indicated, certification of such compliance shall be submitted with shop drawings.
- D. Commencement of Work: Submit shop drawings before any work is commenced.

1.5 STORAGE OF MATERIALS

- A. Do not store fiberglass insulation within the building until it has been "dried in". If no other dry space is available and this insulation must be installed or stored before the building is "dried in" and completely enclosed, provide polyethylene film cover for protection.

1.6 COMPLIANCE WITH CODES AND STANDARDS

- A. Applicable Codes: The total insulation system including insulation, sealant, finishes, etc., shall comply with or exceed all code requirements.
- B. NFPA: All materials and adhesives used shall conform to the requirements of NFPA 90A as to flame spread and smoke developed ratings.

1.7 DEFINITIONS AND TERMINOLOGY

- A. Terminology: Throughout this section, insulation products may be described as regards the location, surface or other point at which they are to be applied. Except in special cases (where a detailed indication or description will be given), the majority of conditions can be defined in whole or in part by use of (but not necessarily limited to) any or all of the following words:
 - 1. "Internal" or "External".
 - 2. "Interior" or "Exterior".
 - 3. "Concealed" or "Exposed".
 - 4. "Protected" or "Unprotected".
- B. Definitions: Wordage used to describe locations, surfaces or other points or conditions shall be defined as follows as related to this section. Where the ascertainment or determination of locations, surfaces and other conditions is obvious from the intent of use of the item (e.g., roof-mounted ductwork, underground piping, etc.) or from other information, then the following words may not be required. If any ambiguity should occur, provide bid based on the most severe condition; however, obtain clarification from Architect/Engineer prior to installation:
 - 1. "Internal" and "External": Relates to an item or its surface which is to be insulated or uninsulated. Does not relate to the confines of the building, structure or other entity in which the item is located. (Examples: internal/external surfaces of ductwork, pipe, air handling units or other such items.)
 - 2. "Interior": Relates to the location of an item as to whether the item is within a heated, ventilated, air conditioned or otherwise controlled environment of the building, structure or other entity in which the item is located. "Interior" is always "Protected". (Examples(s): Interior ductwork, interior piping, interior air handling units.)
 - 3. "Exterior": Relates to the location of an item as to whether the item is outside (i.e., exterior to) a heated, , air conditioned or otherwise controlled environment of the building, structure, facility or other entity which the item serves or relates. "Exterior" generally means that the item is surrounded by the ambient outside environment. "Exterior" is considered "Unprotected" unless otherwise described. (Examples(s): exterior rooftop air handling units, exterior ductwork, exterior cooling tower, exterior chiller.)
 - 4. "Concealed" and "Exposed": Relates to the visibility of an item. "Concealed" implies out-of-sight from normal view by an occupant, user or employee of the facility when such person is performing their normal function. "Exposed" implies that the item is readily visible by such a person when that person is performing a normal function. (Examples(s): "Concealed interior ductwork" would be out-of-sight in a ceiling plenum, whereas "exposed interior ductwork" would

be readily visible in a mechanical equipment room or in a room which intentionally had no ceiling system.)

5. "Protected" and "Unprotected": Relates to an exterior item which may or may not be sheltered from the outside elements but which exists in contiguous contact with the ambient environment without benefit of any direct heating, ventilating or air conditioning. (Example(s): Piping or ducts located in an open crawl space beneath a building would be "protected/concealed"; in an open parking garage such piping or ducts would be "protected/exposed". Piping or ducts on a rooftop would be "unprotected" and usually "exposed".)

PART 2 - PRODUCTS

2.1 GENERAL

- A. Materials: Materials listed are those used as basis of design; equivalent products of acceptable manufacturers will be accepted. Materials must be approved and recommended by the insulation product manufacturer for the particular application(s).
- B. Flame and Smoke Ratings: Application of insulation materials may require, in many cases, that the final insulation system comply with NFPA 90A with regard to maintaining a flame spread rating of 25 or less and a smoke developed/fuel contributed value of 50 or less. In such cases, verify that the materials comply with the indicated flame spread and smoke developed ratings.
- C. 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.
- D. 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 necessarily mean the manufacturer is approved for all applicable insulation conditions. Each listed manufacturer must still comply with the specific requirements of each insulation condition to be acceptable for the particular application. Acceptable manufacturers of insulation-related products include (but are not necessarily limited to) the following: Armstrong; CertainTeed; Childers Products Co.; Knauf; Manville; Owens-Corning; Pittsburg Corning; Rubatex; Upjohn Co.; Duracote Corporation; Ferro Corporation; Dow Corning Corporation; Duro Dyne Corporation; Goodloe E. Moore, Inc.; 3M Co.; United McGill Corporation; Vimasco Corporation; Foster; Gustin-Bacon; Nomaco Inc.; Insulcoustic; Molded Acoustical Products; Lion Nokorode; Thermacor, and other manufacturers as may be listed for a specific application.

2.2 BASIC MATERIALS

- A. Cellular Glass Insulation: Preformed or block type as indicated or as applicable. Fire, water and vermin retardant; closed cell glass composition; density of 7.2-pcf. Comply with the following: ASTM C 552, "Specification for Cellular Glass Thermal Insulation"; Military Specification MIL-I-24244B. Flame spread rating of "5" and a smoke developed rating of "0" as per ASTM E 84. Recommended temperature applications from -450°F to 1200°F when installed in accord with manufacturer's recommendations. Pittsburg-Corning Foamglas.
- B. Elastomeric Insulation: Preformed (tube), roll or sheet as indicated or as applicable. Nitrile, rubber based, closed cell structure. K factor of 0.28 at 75°F. In tube, roll or sheet form of 3/4-inch thickness, ASTM E 84 flame spread rating of "25" or less and smoke developed rating of "50" or less. Recommended temperature applications from -40°F to 220°F when installed in accord with manufacturer's recommendations. Do not install in return air plenums unless flame spread rating and

smoke developed rating are within constraints of applicable codes. Manufacturers and/or series: Armstrong "Armaflex"; Manville "Aerotube"; "Rubatex"; Gustin-Bacon "Ultra-Foam".

- C. Fiberglass Insulation: Inorganic fibrous glass. Flame spread of "25" or less and smoke developed rating of "50" or less per ASTM E 84.
 - 1. Board: Rigid or semi-rigid form, faced or unfaced as indicated. Stiffness of 475 EI, 800 EI or 1400 EI as indicated.
 - 2. Blanket: Flexible form; faced, unfaced or coated as indicated.
 - 3. Preformed: Jacketed or unjacketed as indicated.
- D. Calcium Silicate Insulation: Preformed or block type as indicated or as applicable. Asbestos free. Rigid hydrous calcium silicate. K factor of 0.42 at 200°F. Density: 14-pcf. Flame spread rating of "0" and smoke developed rating of "0" as per ASTM E 84. Recommended temperature applications up to 1200 °F. Use where indicated only on equipment and surfaces which generate heat; do not use as a cold-surface insulation.
- E. Polyurethane Foam Insulation: Rigid, 90% minimum closed cell polyurethane with a minimum 2.0 lbs. per cubic foot density, compressive strength of 30 psi, and coefficient of thermal conductivity (K-Factor) of not higher than 0.16 @ 75°F per ASTM C-518. Maximum operating temperature shall not exceed 250°F. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1-1/2 inches as tested by ASTM E 84.

2.3 INSULATION PRODUCTS, BASIC

- A. Type PI-1: Pipe insulation, preformed cellular glass. Pittsburg-Corning "Foamglas" or equivalent.
- B. Type PI-2: Pipe insulation, preformed jacketed fiberglass. Jacketed with factory-applied kraft reinforced foil vapor barrier jacket. Jacket closure system of double pressure-sensitive adhesive on longitudinal joints; self-sealing butt strips at circumferential joints; provide positive vapor barrier seal. Thermal conductivity (K) of 0.24 at 100°F. Owens-Corning Fiberglas ASJ/SSL-II; Manville Micro-Lok with AP-T Plus jacket; CertainTeed 500 Snap-On; or equivalent.
- C. Type PI-3: Pipe insulation, preformed unjacketed fiberglass. Suitable for field-jacketing. Thermal conductivity (K) of 0.23 at 100°F. Owens-Corning Fiberglas No-Wrap, Manville Micro-Lok, or equivalent.
- D. Type PI-4: Pipe insulation, preformed segmental rigid calcium silicate. Thickness as indicated; provide single layer where nominal pipe size allows; provide "factory nested" double layer when nominal pipe size so requires for the thickness indicated. Owens-Corning Kaylo; Manville Thermo-12; or equivalent.
- E. Type PI-5: Pipe insulation, preformed elastomeric. Rubatex, Armaflex II, K-FLEX or equivalent.
- F. Type PI-6: Pipe insulation, polyurethane foam. Either spray applied or high pressure injected with one shot into the annular space between carrier pipe and jacket. Polyurethane foam shall completely fill the annular space between the service pipe and jacket, and shall be bonded to both.
- G. Type I-1: Cellular glass block insulation. Field formed, fitted and finished as required for the application. Pittsburg-Corning Foamglas or equivalent.

- H. Type I-2: Calcium silicate block insulation. Field formed, fitted and finished as required for the application. Owens-Corning Kaylo; Manville Thermo-12; or equivalent.
- I. Type I-3: Elastomeric insulation. Field formed, fitted and finished as required for the application. Armaflex, Rubatex or equivalent.
- J. Type I-4: Fiberglass flexible blanket insulation. Unfinished, non-combustible, wool-like; composed of long glass fibers bonded with a thermosetting resin. Thermal conductivity (K) of 0.23 at 100°F. Applicable where indicated for boilers, vessels, breaching and stacks operating at up to 1000°F. Finished or held in place by wire ties, metal lath, lagging or as indicated. Owens-Corning Thermal Insulating Wool TIW Type II or equivalent.
- K. Type DI-1: Duct insulation, fiberglass flexible blanket wrap. Composed of flexible blanket of glass fiber factory laminated to a reinforced foil kraft (FRK) vapor barrier with a minimum 2-inch taping and stapling flange on one edge. Suitable for operation at temperatures from 40°F to 250°F. Thermal conductivity of 0.27 at 75°F. Minimum density of three-quarter (3/4) pound per cubic foot. Provide in thickness of 2.2 inches (minimum installed R value of R-6) unless otherwise specified as 2-1/2 or 3-inch thickness. Owens-Corning All Service Faced Duct Wrap; Manville R-Series Microlite; CertainTeed Standard Duct Wrap; or equivalent.
- L. Type DI-2: Duct insulation, 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 barrier; alternate vapor barrier 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 greater than 0.23 at 75°F. Provide in thickness of one (1) inch unless otherwise indicated. Provide with minimum density of 3-pcf unless 6-pcf is specifically indicated. CertainTeed Industrial Insulation Board Type IB-300 (or IB-600); Manville 800 Series Spin-Glas Type 814 (or 817); Owens-Corning 700 Series Industrial Insulation Board Type 703 (or Type 705); or equivalent.

2.4 INSULATION ADHESIVES, MASTICS, SEALANTS

- A. Adhesive (Type A-E1): For joints and seams in elastomeric insulation (Type I-3) not requiring weather protection. Rubatex R-373 Insulation Adhesive; Armstrong 520 Adhesive or equivalent.
- B. Joint Sealant (Type JS-CG1): Non-hardening vapor barrier sealant specifically designed for use with cellular glass insulation (Types PI-1, I-1): Foster's 30-45N Foamseal Sealant, Pittsburgh-Corning Pittseal 444N Sealant, Childers CP-76 or equivalent.
- C. Adhesive (Type A-F1): For adhering fiberglass blanket and board insulations (Types DI-1, DI-2) to metal substrate such as ductwork. Insulcoustic I-C 201, Foster 85-20 or equivalent.
- D. Mastic, General Purpose (Type M-GP1): Non hardening vapor barrier general purpose mastic. For use where indicated or otherwise applicable. Foster GPM 35-00 or equivalent.

2.5 INSULATION FINISHES, JACKETS AND COVERS

- A. Finishing Coating (Type FC-E1): For weather protection of elastomeric insulations (Types I-3, PI-5). K-FLEX 374 coating; Armacell Armaflex WB Finish or equivalent.
- B. Finish Mastic (Type FM-CG1): For cellular glass insulations (Types PI-1, I-1). Waterproof, weather, acid and alkali resistant asphalt mastic coating for use in the range of -40°F to 200°F (installation must be done when in the 50°F to 120°F range). Pittsburgh-Corning Pittcote 300 Vapor and Weather Barrier Finish or equivalent.

- C. Finish Fabric (Type FF-CG1): For cellular glass insulations (Types PI-1, I-1). 6 x 6 meshes per inch polyester fabric for reinforcing the finish mastic. Pittsburg-Corning PC Fabric 79 or equivalent.
- D. Finish Fabric, General Purpose (Type FF-GP1): Nylon membrane. For use generally with fiberglass duct insulations (Types DI-1, DI-2) at joints or seams or as may be indicated. Apply using Foster GPM 35-00 or equivalent.
- E. Jacket, Underground Pipe (Type JP-UG-1): Extruded, black, high density polyethylene (HDPE), having a minimum wall thickness not less than 100 mils for pipe sizes less than or equal to 12", 125 mils for jacket sizes larger than 12" to 24", and 150 mils for jacket sizes greater than 24". No tape jacket allowed. The inner surface of the HDPE jacket shall be oxidized by means of corona treatment, flame treatment, or other approved methods.
- F. Jacket, Pipe, PVC (Type JP-PVC): All purpose, UL-rated, white vinyl jacket, with or without self-sealing feature. Pittsburg-Corning "UNI-JAC" or equivalent.
- G. Jacket, Pipe, Aluminum (Type JP-A1): Aluminum jacketing, 0.016 inches thick, type 3003 alloy, H-14 temper, circumferentially corrugated, with a continuously laminated moisture barrier of one mil polyethylene film and a protective layer of 40 lb. virgin kraft paper. Childers Products Co. "Corolon"; General Aluminum Supply Co. (Gasco); Insulcoustic "Alcorjac", K-FLEX CLAD AL or equivalent.
- H. Pipe Fitting Covers, PVC (Type PFC-PVC): Insulated polyvinyl-chloride fitting covers in shapes as required; with fiberglass insulation insert. Suitable for temperature range of 0°F to 450°F. Flame spread rating of 25 or less and smoke developed rating of 50 or less when kept below 150°F. Acid, alkali and chemical resistant. Suitable for painting if required. Manville Zeston 25/50 PVC Insulated Fitting Covers or equivalent.
- I. Pipe Fitting Covers, Aluminum (Type PFC-A1): Aluminum fitting covers, 0.020 inches minimum thickness, type 3003 alloy, H-14 temper prefabricated fitting covers with baked epoxy moisture barrier for pipe sizes through 24". Field fabricate fitting covers for pipe sizes larger than 24" using 0.020 inches thick aluminum roll jacketing with laminated polyethylene/kraft moisture barrier. Childers Products "Ell-Jacs", "Gore Ell-Jacs", "Tee-Jack", "End-Caps", and "Flange Jacs" or equivalent.

2.6 RELATED PRODUCTS

- A. Wire (Type W-1): Dead soft, 16-gauge, stainless steel.
- B. Straps (Type ST-1): Stainless steel T-304 (18-8) soft annealed with deburred edge with stainless steel wing seals. Childers Products "Febstraps" or equivalent.
- C. Tape (Type T-1): High tensile strength rope stock flat back paper pressure sensitive tape. Pittsburg-Corning "PC Tape No. 25" or equivalent.
- D. Screws (Type S-1): 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 indicated as being acceptable for a particular application, provide field formed, fitted and finished insulation systems if

such application is more practical (such as due to size, configuration or dimensions which may be outside of the availability ranges for size, dimension and/or thickness of preformed products).

B. Pre-installation:

1. Do not apply insulation adhesives, materials or finishes until the item to be insulated has been completely installed and tested and proved tight and suitable for insulation.
2. Prepare surfaces to be clean and dry before attempting to apply insulation.

C. Insulation Shields: Provide hanger or pipe support shields of 16 gage (minimum) galvanized steel over or embedded in the insulation. Shield shall extend halfway up the pipe insulation cover and at least 6" on each side of the hanger. Securely fasten shield with pipe straps at each end.

D. Valves, Cocks and Specialties: Insulate as for the related piping system in which they are located unless otherwise indicated.

E. Factory Pre-insulated Components: Where equipment and other system components are specified in other sections to have factory installed insulation, then no additional insulation is required as work of this section unless additional non-factory-installed insulation is specifically described. Examples of such equipment and components which may not require additional insulation include, but are not necessarily limited to, boiler vessels, chiller evaporators, air handling units, airside terminal units, and similar items.

F. Minimum Thicknesses: Insulation thicknesses which are indicated are minimum thicknesses. Contractor may provide the same insulation material in greater thickness as an aid to installation and handling procedures or due to material availability and procurement considerations.

G. Branch Runouts: Branch runouts are considered to be individual supply/return pipes to individual terminal heating or cooling units (duct mounted coils, airside terminal units with heating coils, fan coil units, humidifiers, and similar small equipment). The supply/return pipe to such units is not considered to be a branch runout if the length of the supply or return pipe exceeds 12'-0" in length to the coil/unit connection.

H. Steam Supply Piping Systems and Steam Condensate Return Piping Systems:

1. Supply Piping System: Shall be considered as the portion of the steam piping systems which conveys steam to a point of direct use at an equipment item which utilizes the steam for humidification or other useful purpose. Such piping conveys steam in or at its vapor phase condition.
2. Condensate Return Piping System: Shall be considered as all portions of the steam piping system which are not part of the steam supply pipe system. Such piping generally conveys steam condensate, exhaust or vented steam, feedwater, blowdown and similar forms of piping on the low pressure (downstream) side of steam traps and relief valves.

I. Steam System Classifications: Steam systems of the following classifications shall be considered to operate within the following temperature and pressure ranges. See performance data scheduled, specified or shown for applicable operating conditions.

1. Low pressure: 0 to 15-psig; up to 250°F.
2. Medium pressure: Between 15-psig and 60-psig; between 251°F and 305°F.
3. High pressure: Over 60-psig; between 306°F and 450°F.

J. Insulation for Plumbing Systems: See other sections describing insulation for plumbing systems.

3.2 INSULATION THICKNESS FOR PIPING SYSTEMS

A. General:

1. Basis: Insulation thicknesses for piping are given for insulation installed in the locations indicated. Thicknesses are based on the various conditions of temperature, usage and environment which are typically encountered.
2. Applicable Thicknesses: All thicknesses as applicable to all conditions may not be given in this section article. Where an insulation thickness for a particular application is specified to be of other thickness than may be listed in this section article, "INSULATION THICKNESSES FOR PIPING SYSTEMS", then provide the insulation in the thickness indicated in other portion of this section which specifically describes the particular insulation application and its required insulation thickness. Thicknesses for other than piping insulation are given in the specific description of the particular application or description of the particular material used.
3. Ambient Conditions: Unless otherwise indicated, ambient conditions for the purpose of describing insulation thicknesses are related to cold applications to prevent condensation or excessive heat gain (e.g., chilled water pipe, cold vessels) and are related to hot applications to prevent harm to personnel or to prevent objectionable heat loss to the environment (e.g., hot water pipe, hot vessels, hot stacks).
 - a. These conditions are generally:

Interior: 80°F and 80% RH.
Exterior: 90°F and 80% RH.
4. Thickness Requirements: Thicknesses are given below based on the following information:
 - a. General type of fluid or process involved (e.g., chilled water, hot water, steam, refrigerant).
 - b. General location and, if necessary, conditions related to temperature (either or both internal or external to the insulation barrier) and ambient environment of the insulated item.
 - c. Pipe size range.

- B. Chilled Water Piping Systems: Fluid generally considered to be between 40°F and 65°F. Thickness is for cellular glass unless other insulation material is indicated.

<u>Location or Description</u>	<u>Pipe Size (inches)</u>	<u>Insulation Thickness</u>
Interior	Up to 1	1-1/2"
Interior	1-1/4 to 4	2"
Interior	6 and up	2-1/2"
-----	-----	-----
Exterior	Up to 4	2-1/2"
Exterior	6 and up	3"
-----	-----	-----
Underground	All Sizes	3"
-----	-----	-----

- C. Hot Water Piping Systems, Low Temperature: Fluid generally considered to be 200°F or less. Thickness is for fiberglass insulation except where annotated by the letter "G" in which case the

insulation thickness is for cellular glass unless other insulation material is indicated. An asterisk (*) indicates branch runouts.

Location or Description Pipe Size (inches) Insulation Thickness

Interior*	Up to 2	1/2"
Interior	Up to 2	1"
Interior	2-1/2 and up	1-1/2"
-----	-----	-----
Exterior, Protected	Up to 2	1-1/2"
Exterior, Protected	2-1/2 and up	2"
-----	-----	-----
Exterior, Unprotected	Up to 2	1-1/2"G
Exterior, Unprotected	2-1/2 and up	2" G
-----	-----	-----
Underground	Up to 4	2"
Underground	5 to 14	2-1/2"
Underground	16 and up	3"
-----	-----	-----

- D. Steam Supply Piping Systems, Medium and Low Pressure: Fluid generally between 200°F and 305°F. Thickness is for fiberglass insulation except where annotated by the letter "G" in which case the insulation thickness is for cellular glass unless other insulation material is indicated. An asterisk (*) indicates branch runouts.

Location or Description Pipe Size (inches) Insulation Thickness

Interior*	Up to 2	1-1/2"
-----	-----	-----
Interior; and Exterior, Protected	Up to 1	2"
-----	-----	-----
Interior; and Exterior, Protected	1-1/4 to 4	2-1/2"
-----	-----	-----
Interior; and Exterior, Protected	5 and up	3"
-----	-----	-----
Exterior, Unprotected	Up to 4	2"G
Exterior, Unprotected	5 and up	2-1/2"G
-----	-----	-----
Underground	Up to 4	2"
Underground	5 and up	2-1/2"
-----	-----	-----

- E. Steam Supply Piping System, High Pressure: Fluid between 306°F and 450°F. Thickness is for fiberglass insulation except where annotated by the letter "G" in which case the insulation thickness is for cellular glass unless other insulation material is indicated.

Location or Description Pipe Size (inches) Insulation Thickness

Interior; and Exterior, Protected	Up to 2	2-1/2"
-----	-----	-----
Interior; and Exterior, Protected	2-1/2 to 4	3"
-----	-----	-----
Interior; and Exterior, Protected	5 and up	3-1/2"
-----	-----	-----
Underground	Up to 4	2"
Underground	5 to 8	2-1/2"
Underground	10 and up	3"
-----	-----	-----

- F. Steam Condensate Return Piping System (including all related piping for steam vent, steam blowdown, pumped steam condensate return, and feedwater). Thickness is for fiberglass insulation except where annotated by the letter "G" in which case the insulation thickness is for cellular glass unless other insulation material is indicated. An asterisk (*) indicates branch runouts.

Location or Description Pipe Size (inches) Insulation Thickness

Interior*	Up to 2	1"
-----	-----	-----
Interior; and Exterior, Protected	Up to 1	1-1/2"
-----	-----	-----
Interior; and Exterior, Protected	1-1/4 and up	2"
-----	-----	-----
Exterior, Unprotected	Up to 4	2"G
Exterior, Unprotected	5 and up	2-1/2"G
-----	-----	-----
Underground	Up to 4	2"
Underground	5 and up	2-1/2"
-----	-----	-----

3.3 CHILLED WATER PIPING SYSTEMS

- A. Interior, Concealed (e.g., ceiling plenums): Insulate with prefabricated, cellular glass pipe insulation (PI-1, I-1). Butter joints with joint sealant (JS-CG1) and secure each section with not less than two wires (W-1). Finish with a layer of fabric (FF-CG1) applied between two glove coats of mastic (FM-CG1). Mastic and fabric shall be applied in strict accordance with the manufacturer's recommendations.

- B. Interior, Exposed (e.g., central mechanical rooms, air handling unit rooms): Insulate with prefabricated, cellular glass pipe insulation (PI-1, I-1). Butter joints with joint sealant (JS-CG1) and secure each section with not less than two wires (W-1). Finish with jacketing (JP-A1). Secure jacketing with straps. Finish elbows and fittings with fitting covers (PFC-A1). Secure fitting covers with screws (S-1) and secure jacketing with straps (ST-1). Finish materials shall be applied in strict accordance with the manufacturer's recommendations.
- C. Interior, Exposed, Special Locations: Same as for "Interior, Concealed" with the additional requirement that the final coat of mastic for the insulation finish shall be especially gloved and finished smooth to accept painting of color(s) required in other divisions as specially selected by the Architect/Engineer. These special locations consist of exposed piping in the following normally occupied areas of the building:
 - 1. Gymnasium.
 - 2. Natatorium.
- D. Exterior, Protected: Same insulation system as for "Interior, Exposed" except thickness as required.
- E. Exterior, Unprotected: Same insulation system as for "Exterior, Protected" except thickness as required.
- F. Underground: Pre-engineered underground jacketed insulation using polyurethane foam insulation (Type P1-6) with high density polyethylene jacket (Type JP-UG-1). Straight run joints shall be field-insulated per the manufacturer's instructions, using polyurethane foam poured in an HDPE sleeve and sealed with a heat shrink sleeve. All joint closures and insulation shall occur at straight sections of pipe. All insulation and jacketing materials shall be furnished by pre-insulated piping system manufacturer. Fittings shall be factory pre-fabricated and pre-insulated with polyurethane foam to the thickness specified and jacketed with a one-piece seamless molded HDPE fitting cover and a butt fusion welded, or an extrusion welded and mitered HDPE jacket. Unless otherwise stated, provide a minimum 48 inch cover for all underground pipe.
- G. Underground Expansion Joints, Expansion Elbows and Expansion Loops: Pre-insulated piping system manufacturer shall engineer, size, and provide expansion/contraction compensation based on underground piping shop drawings. Compensation will be accomplished utilizing factory pre-fabricated and pre-insulated expansion elbows, Z-bends, expansion loops, and anchors specifically designed for the intended application. External expansion compensation utilizing flexible expansion pads (minimum one inch thickness), extending on either side, both inside and outside the radius of the fittings are to be used with all fittings having expansion in excess of 1/2".

3.4 HOT WATER PIPING SYSTEMS

- A. Interior, Concealed: Insulate with glass fiber insulation (PI-2) with all purpose jacket. Elbows, joints, valves, unions and all like items shall be insulated using closely mitered insulation and wrapped with glass fabric and mastic or these items may be insulated and jacketed using pipe fitting covers (PFC-PVC). Install in strict accordance with the manufacturer's recommendations.
- B. Interior, Exposed: As specified for "Interior, Concealed", except finish with aluminum jacketing (JP-A1) and fitting covers (PFC-A1). Secure fitting covers with screws (S-1) and secure jacketing with straps (ST-1). Finish materials shall be applied in strict accordance with the manufacturer's recommendations.
- C. Interior, Exposed, Special Locations: Same as for "Interior, Concealed" with the additional requirement that the final coat of mastic for the insulation finish shall be especially gloved and finished smooth to accept painting of color(s) required in other divisions as specially selected by the Architect/Engineer. These special locations consist of exposed piping in the following normally occupied areas of the building.

1. Gymnasium.
 2. Natatorium.
- D. Exterior, Protected: Same insulation system as for "Interior, Exposed" except thickness as specified.
- E. Exterior, Unprotected: None applicable.
- F. Underground: Same insulation system as for "Chilled Water Piping Systems" in this location except thickness as specified.
- G. Underground Expansion Joints, Expansion Elbows and Expansion Loops: Same as for "Chilled Water Piping Systems" in this location except thickness as specified.
- 3.5 STEAM SUPPLY PIPING SYSTEMS LOW AND MEDIUM PRESSURE AND STEAM CONDENSATE RETURN PIPING SYSTEM
- A. Interior, Concealed: Same insulation system as for "Hot Water Piping Systems" in this location except thickness as specified.
- B. Interior, Exposed: Same insulation system as for "Hot Water Piping Systems" in this location except thickness as specified.
- C. Exterior, Protected: Same insulation system as for "Interior, Exposed" except thickness as specified.
- D. Exterior, Unprotected: Same insulation system as for "Chilled Water Piping systems" in this location except thickness as specified.
- E. Underground: *Same insulation system as for "Chilled Water Piping systems" in this location except thickness as indicated and carrier pipe as specified. **NEEDS EDITING***
- F. Underground Expansion Joints, Expansion Elbows and Expansion Loops: Same insulation system as for "Chilled Water Piping Systems" in this location except thickness as specified.
- 3.6 STEAM SUPPLY PIPING SYSTEMS, HIGH PRESSURE
- A. Interior, Concealed: Same insulation system as for "Hot Water Piping Systems" in this location except thickness as specified.
- B. Interior, Exposed: Same insulation system as for "Hot Water Piping Systems" in this location except thickness as specified.
- C. Exterior, Protected: Same insulation system as for "Interior, Exposed" except thickness as specified.
- D. Exterior, Unprotected: None applicable.
- 3.7 DUCT SYSTEMS
- A. General:
1. Extent of external insulation for duct systems are described below:
 - a. All supply ductwork.
 - b. All return ductwork.

- c. All ductwork located within a building attic space subject to natural or mechanical ventilation.
 - d. All outdoor air ductwork located in or above a conditioned space or located within a building shaft or chase.
- 2. Extent of duct systems not to be insulated are described below:
 - a. All exhaust ductwork.
 - b. All kitchen exhaust ductwork.
 - c. All outdoor air ductwork unless otherwise indicated.
- 3. Internal Insulation: Ductwork which is required to be insulated internally (acoustically/thermally lined) shall be insulated as work of the section entitled "Ductwork".
- 4. External Insulation: Ductwork which is required to be insulated externally shall be insulated as work of this section.
- 5. Factory Insulation: Ductwork which is factory manufactured with internal or external insulation is not to be additionally insulated as work of this section unless specifically stated. Such factory insulated ductwork generally consists of flexible externally insulated ductwork and double walled acoustically thermally lined ductwork.
- B. Interior, Concealed (e.g., ceiling plenums): Where external insulation is required, insulate externally with 2.2 inch thick fiberglass blanket wrap (Type DI-1). The insulation shall be wrapped around the ductwork and have its laps secured with outward clinching stainless steel staples. The insulation shall be held to the bottoms of ductwork over 18" wide with mechanical fasteners spaced 18" on centers. All laps, seams and pin heads shall be sealed vapor tight with Compac #120 Aluminum Foil Tape coated with Foster 30-65 Vapor-Fas WB Coating
- C. Interior, Exposed, (e.g., air handling unit rooms): Where external insulation is required, insulate with 1-1/2-inch thick semi-rigid fiberglass board (Type DI-2). Adhere to ductwork with adhesive (Type A-F1). Finish joints and seams with finish fabric (Type FF-GP1).
- D. Interior, Exposed, Special Locations: Same as for "Interior, Exposed" with the additional requirement that insulation finish shall be especially gloved and finished smooth to accept painting of color(s) required in other divisions as specially selected by the Architect/Engineer. These special locations consist of exposed ductwork in the following normally occupied areas of the building. Refer to architectural reflected ceiling plans and correlate mechanical plans for extent of exposed ductwork.

3.8 DUCT SYSTEMS EQUIPMENT

- A. General: Insulate as follows unless detailed to a greater extent on the Drawings.
- B. Fire damper and Fire/Smoke Damper External Surfaces:
 - 1. Externally Insulated Duct Locations: Extend duct insulation up face of fire damper to damper sleeve. Seal insulation edges with 4-inch minimum width UL 181A listed mastic and fabric..
 - 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 UL 181A listed mastic and fabric.
- C. Air Distribution Devices: Insulate the backs of all ceiling diffusers and other air outlet devices installed in other than return air plenums as specified for interior concealed ducts.

3.9 COLD EQUIPMENT AND RELATED COMPONENTS

- A. Pump Volutes for Chilled Water Systems: Insulate with elastomeric sheet insulation (Type I-3) out to and including pump flanges. Provide cutouts or removable sections as required to provide access to grease fittings and similar items and to allow adequate clearance for shaft. Secure the insulation with adhesive (Type A-E1). Insulation thickness shall be one and one-half (1-1/2) inches.
- B. Expansion Tanks(s), Air Separator(s), Buffer Tanks and Chemical Pot Type Feeder(s) for Chilled Water Systems: Insulate with elastomeric sheet insulation (Type I-3). Secure the insulation with adhesive (Type A-E1) applied to a clean surface and finish with a layer of membrane (Type FF-GP1) applied between two glove coats of mastic (Type M-GP1). Insulation thickness shall be one and one-half (1-1/2) inch.
- C. Condensate Drain Piping From Cooling Equipment:
 - 1. Interior, and Exterior, Protected: Insulate with preformed elastomeric pipe insulation (Type PI-5) secured with adhesive (Type A-E1) and finished with white finish coating (FC-E1). Thickness 3/4-inch. Provide 25/50 flame/smoke rating.
 - 2. Exterior, Unprotected: None applicable.
- D. Refrigerant Suction Lines (and Refrigerant Liquid Lines if required by unit manufacturer) and Hot Gas By-pass and Return Lines (if applicable):
 - 1. Interior and Exterior, Protected and Unprotected: Insulate with preformed elastomeric pipe insulation (Type PI-5) secured with adhesive (Type A-E1) and finished with white finish coating (FC-E1). Thickness 1-inch for 3/4-inch lines, 1-1/2-inch for 1-inch and larger lines. Provide 25/50 flame/smoke rating. Provide aluminum jacketing for exterior applications. Provide factory applied aluminum jacketing for exterior applications. Field applied aluminum jacketing is not acceptable.
- E. Cold Surfaces at Chillers and Evaporators: Factory insulated. No insulation required as work of this section.
- F. Flexible Pipe Connectors for Vibration Isolation: Insulate with elastomeric insulation (Type I-3). Secure the insulation with adhesive (Type A-E1) applied to a clean surface and finish with white finish coating (FC-E1). Insulation thickness shall be one and one-half inches (1-1/2").

3.10 HOT EQUIPMENT AND RELATED COMPONENTS

- A. Heat Exchangers, Shell and Tube: Insulate with 2-1/2-inch thick calcium silicate insulation (Type -2). Wire insulation securely to vessel and then cover with wire mesh. Apply a 1/2-inch thick finish coat of insulating finish cement over the wire mesh. Trowel external surface to a smooth finish.

END OF SECTION 23 07 00

SECTION 23 09 23 - DIRECT DIGITAL CONTROL SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Special Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. Provide a completely functional Direct Digital Control (DDC) temperature control system, including, but not necessarily limited to:
 - 1. Controls for all items indicated on the drawings and described in this section, including thermostats, temperature transmitters, pressure sensors, valves, switches, relays, temperature control panels for instruments, and all associated wiring.
 - 2. Control valves and valve actuators, with pilot positioners as required.
 - 3. Automatic control dampers and electric damper operators.
 - 4. Direct Digital Control panels (Standalone Control Units), complete with power supplies, input/output boards, communications boards, and all other equipment required for a functional DDC system.
 - 5. Temperature sensors, pressure sensors, humidity sensors, start/stop relays, transducers, and any other auxiliary input/output devices required for a completely functional DDC system.
 - 6. Calibration adjustment, and startup of the temperature control system.
 - 7. Instruction of Owner's personnel on maintenance and operation of the temperature control system and DDC Panels.
 - 8. Composite electric control diagram showing interlocking equipment and interconnection with the DDC Control system.
 - 9. Associated electrical wiring and conduit.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division-23 and to all other applicable portions of the Drawings and Specifications.
- B. Electrical: Division-26.

1.4 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies: Control system components shall comply with all legal requirements, including requirements of UL, NFPA, FM and FCC.
- B. Materials Quality: Provide all controls from one manufacturer, except as otherwise specified. Acceptable Manufacturers will be considered to be Trane,,KMC, Siemens, Schneider Electric, Alerton

, Johnson Controls (corporate Johnson Controls local office – independent controls installers and vendors shall not be acceptable) or equal. All materials and equipment used for the DDC system shall be standard components manufactured for this system and shall not be custom designed especially for this project. BACnet communication protocol shall be used unless otherwise indicated.

- C. Workmanship Quality: Install a complete control system, with competent mechanics and electricians regularly employed by the Control Contractor.
 - 1. Supervise installation of control valves, control dampers and thermometer wells to be installed in pipes and ducts by other sections.
- D. Tests and Inspections: Provide tests and inspections as required to prove to the satisfaction of the Owner and Owner's representative that the controls perform as specified.

1.5 SUBMITTALS

- A. Procedures: Provide Technical Information Brochures and Shop Drawings in accordance with Section 230100.
- B. System Specifications: Submit manufacturer's data on all integrated components to the Owner for approval, including wiring diagrams and descriptions of the location and sizes of all temperature control panels and DDC panels. Control diagrams shall include:
 - 1. Detailed sequences of operation.
 - 2. Detailed descriptions of points of interconnection to the mechanical equipment.
 - 3. Complete lists of all control devices being used, cross-referenced to the control diagrams, indicating manufacturer's model number, quantity used, and calibration information.
 - 4. Point list of all input and output points, with descriptions of point type and service.
 - 5. Locations of all DDC system equipment, a detailed description of the DDC system configuration and descriptions of all software packages required.
- C. Product Data: Submit manufacturer's published literature for all control equipment, including all devices, thermostats, control valves, control dampers, controllers, DDC system panels, sensors, transducers, modems, relays and other specified equipment.
- D. Maintenance Data and Operating Instructions: Upon completion of the installation, submit to the Owner for approval, 3 sets of control manufacturer's published Operating and Maintenance data catalogs.
 - 1. After the installation is complete and has been accepted by the Owner, provide one eight-hour periods of instruction on the DDC control system, to be scheduled at the convenience of the Owner's personnel. Instruction on the control system shall include all operating procedures, control system configuration, calibration and adjustment procedures, routine maintenance procedures and DDC control algorithms.
 - 2. After completing the installation, furnish to the Owner for approval, three sets of "as built" control diagrams indicating all field changes to the control system during installation, test and adjustment of the controls.

1.6 COORDINATION

- A. Coordinate the work of this Section with other trades for the related work to complete the automatic temperature control system. Furnish to other trades all information, data, installation details, diagrams and instructions for their performance.
- B. Carefully check space requirements with other trades to ensure that all materials can be installed in the spaces allocated.
- C. Transmit all information required for work to be provided under other Sections in ample time for installation.
- D. Wherever work specified under this Section interconnects with work under other sections, coordinate work to insure proper installation of all necessary connections and equipment.
- E. Furnish and set all sleeves for passage of electric conduit and piping through masonry and concrete walls and floors as required to protect piping and wiring passing through building surfaces.
- F. Coordinate, protect and schedule work of this Section with other trades in accord with the construction sequence.

1.7 WIRING AND CONDUIT

- A. Provide all conduit, wire, junction boxes and other electrical equipment as required for a complete control system. All wiring shall be plenum rated. All wiring and tubing shall be installed in conduit where exposed (including mechanical rooms).
- B. All electrical materials and equipment shall comply with the requirements of Division 26.

1.8 TAGS, CHARTS AND IDENTIFICATION

- A. Tag automatic control valves, dampers and controlled devices in an approved manner.
- B. Provide screw-fastened engraved phenolic nameplates with 1/4-inch high white lettering on black background, clearly indicating the function, designation or equipment controlled, for panels and all control items listed on the control diagrams.
- C. Provide full-size as-built shop drawings framed and under glass or laminated and wall-mounted at each control panel location or mechanical system.

1.9 GUARANTEE

- A. In addition to the requirements of Division-01 and Section 230100, the control system herein specified, including all DDC hardware and software components, shall be free from defects in workmanship and material under normal use and service for a period of no less than twelve months commencing at the time of final acceptance of the facility by the Owner. After completion of the installation the Controls Contractor shall adjust all thermostats, control valves, motors and other equipment provided under his contract. If within the warranty period, any of the equipment herein described is proved to be defective in workmanship or materials, it shall be replaced or repaired free of charge.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT FOR TEMPERATURE CONTROL

- A. Electric Controls:

1. Room Temperature Sensors: Provide fully proportioning room Temperature Sensor with a scale range of 55 to 85 degrees F. Each temperature sensor shall be equipped with timed after hours override control. Provide with integral humidity sensor and carbon dioxide sensor were shown in same room on plans. Color and finish of cover shall match that of adjacent light switches, and be mounted at the same height.
2. Low Temperature Detector: Provide a freeze protection thermostat upstream of each cooling coil on units with outside air to stop the fan on low temperature. The thermostat shall have a SPST switch with 35 to 45°F range with automatic reset and 8°F differential. The thermostat shall switch whenever any one foot or more of the sensing element is below the set point.
3. Relays, Switches and Miscellaneous Electrical Control Devices: Provide any relays, switches or auxiliary control devices as required to provide a complete control system as detailed herein and in the plans and as described by the sequence of operation.

B. Controlled Devices:

1. Automatic Control Valves: Furnish automatic control valves for installation in the piping system.
 - a. Three-Way Control Valves: Provide fully proportioning three-way ball valves with characterized disc. Size valves for pressure drop range of 2-5 PSI.
 - b. Two-way Control Valves: Provide fully proportioning two-way ball valves with characterized disc. Size valves for pressure drop range of 2-5 PSI. Line-size butterfly valves may be used for isolation service.
 - c. Two-Way Control Valves: Provide pressure independent balance and control type. Control valves shall be two-way type single seated valves for modulating service. Valves less than 2" line size shall meet ANSI Class IV leakage rating with NPT connections. Body pressure rating shall be ANSI Class 125 or ANSI Class 250 or better and connection type construction shall conform to pipe, fitting and valve schedules for valves 2-1/2 inches or larger with flanged connections. Basis of design: Siemens, Belimo or Danfoss.
2. Valve Actuators: Valve actuators for automatic valves shall be capable of positioning the valves smoothly and accurately and closing the valves against the differential pressures involved. All actuators for modulating service to be fully proportional. Floating point actuators are not acceptable.
3. Control Dampers: Provide all automatic control dampers for installation under Section 233314.
 - a. Dampers shall be aluminum Ruskin CD50 double-skin airfoil design or equivalent. Frames shall be 5" x 1" x .125" (minimum thickness) 6063T5 extruded aluminum hat channel with hat shaped mounting flanges on both sides of the frame. Damper blades shall be airfoil type extruded aluminum for superior pressure drop and low noise generation. Each blade shall be maximum 6" depth with integral structural reinforcing tube running full length. Minimum thickness of blade shall be .070. Blade edge seals shall be flexible and suitable for -72°F (-60°C) to +275°F (+135°C) mechanically locked in extruded blade slots yet easily replaceable in field. Jamb seals shall be flexible stainless steel, compression type to prevent leakage between the end of the blade and the damper frame. Bearings shall be non-corrosive molded synthetic. Axles shall be 1/2" plated steel hexagonal shaped and to provide positive locking connection to blade.
4. Damper Operators: Operators shall be quiet in operation and have ample power to overcome friction of linkage and air pressure to operate dampers smoothly for velocities up to 2500 fpm.

- a. Provide blade pin crankarm and adequate linkage between operator and damper capable of providing a normally closed or normally open damper position and operating the damper over a 90° stroke.
 - b. Damper operators shall have external adjustable stops to limit the stroke in either direction.
 - c. Damper operators for combinations Fire and Smoke Dampers shall be furnished with the dampers by Section 233314.
- C. Temperature Control Panels: Provide U.L. listed temperature control panels of the latest design, for factory-mounting of all switches, relays, terminal blocks and any other panel-mounted equipment required for a completely functional temperature control system. The control panels shall have a cabinet door supported by a piano type hinge and a master key-locking latch. The panel shall be made of steel or extruded aluminum, with proper bracing for rigid wall or floor mounting.
 - 1. Mark each control device on the panel with engraved nameplates describing its function and cross-referencing it to the control diagrams.

2.2 DIRECT DIGITAL CONTROL (DDC)

- A. The Direct Digital Control (DDC) System specified herein shall be able, without additional equipment, to perform all of the automatic temperature control and energy management functions as required in this specification. Direct Digital Control shall be defined as a control technique through which the process variable is continuously monitored by a digital computer which accomplishes loop control by calculating a control solution with a control algorithm for output to a control device.
- B. The DDC system shall independently control the building's HVAC equipment to maintain a comfortable environment in an energy efficient manner. The building operator shall communicate with the system and be able to control the sequence of operation within the building.
- C. System Architecture: The DDC system shall consist of a network of independent, stand-alone control units (SCU). Each stand-alone control unit shall be capable of performing all specified control functions in a completely independent manner. Additionally, SCU's shall be capable of being networked for single point programming and for the sharing of point information and control instructions between panels. All operator communication with the system shall be via an existing operator terminal at a remote location. It shall be possible for each SCU to have a dedicated local display or for the network of SCU's to share the single remote operator terminal.
- D. Stand-alone Control Unit (SCU):
 - 1. Each SCU shall be capable of full operation either as a completely independent unit or as a part of the building-wide DDC control system. All units shall contain the necessary equipment for direct interface to the sensors and actuators connected to it.
 - 2. Control strategies shall be owner definable at each control unit, and for all control units in the system from the remote operator terminal. Each control unit shall provide the ability to support its own operator terminal if so desired.
 - 3. Each stand-alone control unit shall include its own microcomputer controller, power supply, input/output modules, termination modules, and battery. The battery shall be self-charging and be capable of supporting all memory within the control unit if the commercial power to the unit is interrupted or lost for a minimum of eight (8) hours.
 - 4. The stand-alone control unit shall be listed by Underwriters Laboratories (UL) against fire and shock hazard as a signal system appliance unit.

- E. Sensors/Input Signals: Each stand-alone control unit shall be capable of direct interface to a variety of industry standard sensors and input devices. It shall be possible for each stand-alone control unit to monitor the following types of inputs:

Analog inputs

- 4-20mA - thermistors
- 0-10 vDC - 3-15 psi

Digital inputs

- dry contact closure
- pulse accumulator

- F. Actuators/Output Signals: The stand-alone control unit shall directly control electric actuators and control devices. Each control unit shall be capable of providing the following control outputs:

Digital outputs (contact closure)

- motor starters, sizes 1 to 4

Analog outputs

- 4-20 mA or
- 0-10 vDC

- G. Building Control Functions: Each Stand-alone Control Unit within the DDC System shall perform both temperature control functions and energy management routines as defined by the operator.

1. All temperature control functions shall be executed within the stand-alone control unit. Loop control shall be executed via direct digital control algorithms. The user shall be able to customize control strategies and sequences of control, and shall be able to define appropriate control loop algorithms and choose the optimum loop parameters for loop control. Control loops shall support any of the following control modes:

Two-position (on-off, slow-fast, etc.)

Proportional (P)

Proportional plus integral (PI)

Proportional, integral, plus derivative (PID)

2. It shall be possible to fully create, modify or remove control algorithms within a specific stand-alone control unit while it is operating and performing other control functions. Each control loop shall be fully user definable in terms of:

Sensors/actuators that are part of the control strategy.

Control mode.

Gain.

Control action.

Sampling time.

3. Provide stand-alone control units that are able to share point information such that control sequences or control loops executed at one control unit may receive input signals from sensors connected to other stand-alone control units within the network. If the network communication link fails or the other stand-alone control unit malfunctions, the control loop shall continue to function using the last value received from the stand-alone control units.
4. Each stand-alone control unit shall be capable of performing the following energy management routines as a minimum:

Time of day scheduling.

Start/stop time optimization.
Peak demand limiting.
Duty cycling (temperature compensated).
Economizer control.
Enthalpy changeover.
Supply air reset.
Chilled water reset.
Outdoor air reset.
Event initiated programs.

5. The owner shall be able to create customized control strategies based upon arithmetic, Boolean or time delay logic. The arithmetic functions shall permit simple relationships between variables (i.e. +,-,x) as well as more complex relationships (i.e. square root, exponential).
6. The system shall permit the generation of job-specific control strategies that can be activated in any of the following ways:

Continuously.
At a particular time-of-day.
On a pre-defined date.
When a specific measured or controlled variable reads a selected value or state.
When a piece of equipment has run for a certain period of time.

7. Upon a loss of commercial power to any stand-alone control unit, the other units within the network shall not be affected, and the loss of operation of that unit shall be reported at the remote operator's terminal. All control strategies and energy management routines defined for the stand-alone control unit shall be retained during a power failure via the battery with the unit for a minimum of eight (8) hours. Upon resumption of commercial power, the SCU shall resume full operation without operator intervention. The unit shall also automatically reset its clock such that proper operation of timed sequences is possible without the need for manual reset of the clock.
8. Should a loss of power exceed memory back-up, the building operator shall be able to manually restore all system programs off of compact disc or solid state memory drives. .

H. Operator Interface – Web Access:

1. DDC system software shall be based on server thin-client architecture, designed around open standards of Web technology. DDC system server shall be accessed using a Web browser over DDC system network, using Owner's LAN, and remotely over Internet through Owner's LAN.
2. Intent of thin-client architecture is to provide operators complete access to DDC system via a Web browser. No special software other than a Web browser shall be required to access graphics, point displays, and trends; to configure trends, points, and controllers; and to edit programming.
3. Web access shall be password protected.

H. Operator Interface:

1. The DDC system shall permit full operator communication including; obtaining information about the performance of his system; allowing the operator to change the system operation; and diagnosing system malfunctions. Operator communication shall be through the use of any one of the following operator terminals:
 - hand-held terminal (local)
 - printer (local or remote)
 - Color flat panel LCD screen (remote).

2. It shall be possible to have one operator's terminal at each stand-alone control unit, or to have a single operator's device which can be connected to any panel in the network. The DDC system shall permit complete operation of any stand-alone control unit within the network, from any operator terminal within the system.

I. User Programmability:

1. All temperature control strategies and energy management routines shall be definable by the operator through an operator's terminal. It shall be possible for the operator to modify system functions independently after receiving the training from the control contractor as specified in paragraph 1.04. The system shall be provided complete with all equipment and documentation necessary to allow a trained operator to independently perform the functions listed below:

- read the value of a measured variable (i.e. temperature).
- start or stop equipment.
- monitor the status of equipment being controlled.
- read the set point of a control loop.
- determine the control strategies that have been defined for a specific piece of equipment.
- generate displays of control strategies.
- add/delete control loops to the system.
- add/delete points to the system.
- create, modify or delete control strategies.
- assign sensors and/or actuators to a control strategy.
- tune control loops through the adjustment of control loop parameters.
- enable or disable control strategies.
- generate hardcopy records of control strategies on a printer.
- select points to be alarmable and define the alarm state(s).

J. Expansion Capability:

1. The building control system, as installed, shall permit an easy upgrade to greater functionality and performance through the addition of a central host computer and the necessary operator terminals. The network shall be fully compatible with this additional central computer.
2. An upgrade to a system with a central computer will allow the following functions:
 - support of dynamic color graphic displays
 - maintenance management
 - wider range of English language reports
 - sophisticated trend analysis
3. If the DDC system is upgraded to a system with a central computer it shall not be necessary for the operator to reenter building data or redefine the control strategies already resident within the stand-alone control units.

K. Self Diagnostics and Alarm Reporting:

1. Each stand-alone control unit shall contain self diagnostics that continuously monitor the proper operation of the unit. A malfunction of the unit will be reported, and will inform the operator of the nature of the malfunction, and the control unit affected. It shall be possible to annunciate malfunctions as well as other control unit alarms at the remote terminal.
2. The system shall also allow on-line diagnosis via telephone modem from a remote location.

L. Operator's Terminal:

1. Furnish one personal computer, minimum Intel Core i7 desktop processor or equal, as operator's terminal complete with color monitor, printer and other accessories to the Owner for access and controlling the DDC network.
2. The Operator's terminal shall be able to perform the following functions:
 - Display all point status report.
 - Display alarm report.
 - Add, change or delete points.
 - Change setpoints.
 - Add, change or delete custom control sequences.
 - Command points to a specific state.
 - System shall be equipped with color graphics to indicate building floor plans and equipment locations and operation on real time basis. System shall be provided with modem or communications hardware required for remote system monitoring and adjustment.

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordinate the work of this section with the work of all applicable sections of Division-23 and -26, and all other applicable Divisions.
- B. Install all materials and products furnished in this section in a workmanlike manner with skilled mechanics and electricians regularly employed in the installation of commercial automatic temperature control systems.

3.2 ELECTRIC WIRING

- A. Provide installation of all control wiring, terminations, and required conduit, fittings and related wiring accessories in accordance with the requirements of Division-26.
- B. Provide and install all interlock wiring between electrical equipment and control components required for control interlocking as specified in the sequence of operation and indicated in the control diagrams.

3.3 CALIBRATION AND ADJUSTMENT

- A. Provide calibration and adjustment of the entire control system after the entire installation is complete. Coordinate the calibration of the static pressure controllers with the Test and Balance to ensure proper set points and sensitivities. Place the control system in final operating condition subject to Owner approval.
- B. Provide tests as required by the Owner and/or the Owner's representative to show that the control system is operating as specified.

3.4 AUTOMATIC TEMPERATURE CONTROL SEQUENCES

- A. General: The following sequences of operation are intended to convey the normal operating sequence of each particular system when in the automatic control mode as controlled by the DDC system.
- B. Variable Air Volume Systems:
 1. The air handler unit fan shall be started automatically from the DDC System or manually. When the fan is started, exhaust fans serving the same floor are started, the minimum outside air damper

is opened, variable frequency drive shall ramp up over 30 seconds to the position required by the static pressure control and the digital controls are enabled.

2. The DDC System shall control the normally closed CH.W. cooling coil valve to maintain the supply air temperature at $55^{\circ}\text{F} + 5^{\circ}$ as readjusted by the return air temperature in accordance with the reset schedule.
3. The DDC System shall control the variable frequency drive (VFD) to maintain the duct static pressure at the static pressure transmitter. On an increase in duct static pressure, the variable frequency drive shall slow fan RPM accordingly.
4. The minimum outside air damper shall be closed during an unoccupied period or during morning warmup or cooldown.
5. The air handler unit shall be automatically stopped on fire alarm conditions through the fire alarm system relay, the outside air damper closed and all controls disabled.
6. Zone controls shall be as described under the fan terminal and VAV unit control sequences of operation.
7. The DDC System shall monitor supply air and return air temperature, duct static pressure, fan status and shall control the VAV and fan terminal unit status, CH.W. cooling coil valve, electric heater and minimum outside air damper.
8. Each air handling unit shall be equipped with a humidity sensor that shall override the thermostat setting in order to maintain humidity set point by modulating AHU chilled water valve to full open position.
9. Each individual fan terminal unit and VAV box shall be programmed with its own night setback and time of day schedule in addition to the main air handling units.

C. Chilled Systems:

1. The chilled water pumps (primary or standby) shall be started automatically through the DDC system or manually through the H-O-A switch at the Motor Control Center.
2. The chiller shall be started automatically if enabled at the unit-mounted chiller control panel. If flow is established through the CH.W. flow switch, the chiller shall start fully unloaded.
3. Under emergency power only one chiller and selected AHU's/FC's and pump will be energized coordinate sequences & lead/lag control with electrical/emergency power requirements.

D. VAV & Fan terminal units.

1. VAV boxes shall be controlled through respective room Temperature sensor. VAV damper shall be modulated to achieve room cooling temperature set point. VAV heater shall be staged to achieve room heating set point (where applicable).
2. FTU boxes shall be controlled through respective room temperature sensor. FTU damper shall be modulated to achieve room temperature set point. Upon temperature drop in room, damper shall modulate to minimum set point. Upon further drop in room temperature, FTU fan shall be turned on to mix plenum air into primary air. Upon further drop in room temperature, FTU heater shall be energized.

E. Fans:

1. All fans scheduled with interlocks and EMS controls operate during occupied mode. All fans shall stop during unoccupied mode.
 2. Refer to plans for additional control strategies.
- F. Outside Air Dampers:
1. All outside air intakes shall be provided with motorized damper. Dampers shall be open during occupied mode. All dampers shall be closed during unoccupied mode.

END OF SECTION 23 09 23

SECTION 23 09 25 - VARIABLE FREQUENCY DRIVE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions" for related requirements. Refer to other sections of Division 23 and to all other applicable portions of the drawings and specifications.
- B. This section directly relates in particular to sections (which may or may not be included in this division) which describe the following:
 - 1. Direct Digital Control System and Expansion.
 - 2. Performance Verification.
 - 3. Air Handling Units.
 - 4. Fans.
 - 5. Pumps.
 - 6. Electrical sections.

1.3 WORK INCLUDED

- A. Variable Frequency Drives: Provide and install Variable Torque Variable Frequency Drives (VFD) for variable speed where indicated on the plans, suitable for controlling NEMA Design B motors on continuous duty in variable volume applications. The VFD shall be listed by Underwriter's Laboratories, E.T.L., or CSA as approved by the Engineer and shall comply with the latest standards of ANSI, IEEE and the NEC.
- B. General: The Variable Frequency Drive shall be capable of converting 460V + 10%-5%, three phase, 60 Hz + 2 Hz utility input power to variable frequency, three phase AC power for variable torque motor control continuously from 10% to 110% of base speed. Output shall have voltage to frequency relationship for a 460V, three phase motor. A transformer shall not be required for the input or output to operate on 460V. All general options and modifications shall mount within the VFD enclosure.
- C. Submittals: Provide submittals in accordance with Paragraph titled "Power Factor" of this Section and with Section 230100. In addition, furnish the following technical information for Engineer's review and approval:
 - 1. Complete technical information on the Variable Frequency Drive and all specified options, indicating all cabinet dimensions and space requirements for the VFD, including bypass contactors and line reactors.
 - 2. Complete efficiency versus load and speed data for all VFD ratings showing that the VFD with necessary isolation transformers or line reactors is capable of providing full motor nameplate rated horsepower.
- D. Power Factor: The power factor shall be maintained at 0.95 throughout the speed range of the drive.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. ABB, Square D, Yaskawa, Toshiba, DanFoss, or approved equal by owner.
- B. Furnish VFD and "start-up" services by local vendor within 100 mile radius of jobsite. VFDs provided by unit (air handling unit, fan, pumps, etc) manufacturer are not acceptable unless prior approval from owner/engineer is obtained.

2.2 MATERIALS

- A. The VFD unit shall be totally enclosed in a free-standing NEMA 1 enclosure for interior conditioned space floor mounting or NEMA 4X air-conditioned stainless-steel enclosure for exterior or unconditioned space mounting, and shall be capable of dissipating any heat generated by the VFD circuitry. All unit-mounted controls shall be mounted on the face of the VFD enclosure. VFD shall be capable of operating in an ambient temperature of 0-40°C.
- B. The VFD shall incorporate an input molded case circuit breaker sized to provide a short circuit interrupting capacity of 30,000 symmetrical amps. The input breaker shall be mechanically interlocked with the power unit enclosure door.

2.3 UNIT REQUIREMENTS

- A. Control Interface: Provide a BAS interface with communication protocol coordinated with BAS vendor. The following control interfaces shall be provided at a terminal strip in the VFD as a minimum to assure control system integrity:
- B. Speed Control Input: A 4-20mA signal proportional to speed shall be furnished under Section 230923 to the Fan System for directly controlling the speed of the VFD's when in automatic mode in response to static pressure.
- C. Start/Stop Control: The VFD shall be capable of being started and stopped remotely by a maintained-contact start/stop relay furnished in this section and other remote relay contacts.
- D. Control Interlock: The VFD shall provide an auxiliary control interlock output of 115 VAC whenever the VFD is enabled, to provide interlocking with the control system. The VFD shall be furnished with two sets of N.O. contacts for control interlocking. The VFD shall be provided with a 115 VAC control transformer so that no external 115 VAC power source is required.
- E. Speed Signal Reference: The VFD shall furnish a 0-5 VDC or 4-20mA signal directly proportional to the output frequency of the VFD, for remote monitoring of the VFD speed at the building automation system under Section 230923.
- F. Hand-Off-Auto Switch: The VFD shall be furnished with a door-mounted Hand-Off-Auto switch to allow switching of the speed control signal from the "Automatic" signal to a manually selected speed potentiometer on the VFD when in the "Hand" position. The VFD shall be disabled when in the "Off" position.
- G. VFD Trip Contacts: The VFD shall be furnished with a set of N.O. contacts for remote annunciation to the building automation system under Section 230923.

- H. Speed Potentiometer: A manually selected speed potentiometer shall be door-mounted to manually select the speed when the H-O-A switch is in "Hand" position.
- I. Speed Meter: The VFD shall be furnished with a door-mounted speed meter (0-100%) to indicate the frequency of the VFD.
- J. Manual Bypass with Magnetic Contactors: A door-mounted manual bypass switch shall be provided as a means of bypassing the VFD circuitry for emergency operation. In "normal" mode, the motor is controlled by the VFD. In "bypass" mode the motor is directly connected to the building power. Motor protection thermal overload shall be provided in "bypass" or "normal mode".
- K. Manual bypass shall provide all the circuitry necessary to safely transfer the motor from the VFD to the power line, or from the line to the controller, while the motor is at zero speed. This option shall be located in the VFD cabinet. This enclosure section shall house all devices which must be energized at either 460 VAC or 115 VAC while operating in the bypass mode, for personnel safety.
 - 1. Two motor contactors, electrically interlocked, shall be utilized. One contactor is to be between the VFD output and the motor, controlled by the VFD regulator; and the other one is to be between the bypass power line and the motor, providing across-the-line starting. Motor protection is to be provided in both the "normal" mode and the "bypass" mode by a motor overload relay. The 115 VAC relay control logic, allowing common start-stop commands in the "controller" mode and the "bypass" mode shall also be included within this enclosure.
 - 2. The bypass section door shall include a "VFD-Off-Bypass" selector switch and "VFD Mode" indicator light and a "Bypass Mode" indicator light. Terminals shall be provided for remote light indication of mode selection.
 - 3. The bypass option shall include a door interlocked, main power input disconnect circuit breaker, providing positive shutdown of all input power to both the bypass circuitry and the VFD.
 - 4. The bypass circuit shall include a second door interlocked input disconnect circuit breaker installed in the VFD. This disconnect shall provide the ability to safely troubleshoot and test the controller, both energized and de-energized, while operating in the "bypass" mode.
 - 5. Manual bypass with magnetic contactors shall be factory installed.
 - 6. Manual bypass shall not be provided on fans with direct drive motors that are part of a fan array system (fan quantity greater than 2).
- L. Variable Frequency Drive Controller: The VFD controller shall be completely solid state PWM or variable voltage source design. The VFD shall provide the following standard features:
 - 1. Minimum and Maximum Speed Potentiometers shall be furnished to select a minimum (10-50%) and maximum (50-100%) output frequency.
 - 2. Linear acceleration and deceleration functions adjustable from 4-20 seconds shall be furnished.
 - 3. Safety features shall be provided to protect the VFD internal circuitry and motor, including but not limited to the following:
 - a. Current limit feature to limit output current from 50-110% of that of the inverter rating. The current limit shall be designed to function automatically to prevent overcurrent trip due to momentary overload conditions, without shutdown.

- b. Instantaneous overcurrent trip to safely limit the output current in under 50 micro seconds due to phase to phase short circuits or severe overload conditions, without damage to input fuses or thyristors.
 - c. Under- and over-voltage trip for non-momentary power or phase loss. Automatic restart shall occur on undervoltage condition.
 - d. Drive diagnostic fault indicator for continuous indication of drive status.
 - e. Isolated current and voltage signals from logic circuitry.
 - f. Fast-acting current limiting input fuses.
 - g. In the event of a sustained or momentary power loss, the control shall shut down safely without component failure. Upon return of power, the system shall automatically return to normal operation.
 - h. In the event of phase to phase short circuit on the output due to motor failure or power failure the control shall shut down safely without component failure.
 - i. Overtemperature safety shall be provided to shut down the VFD if the internal temperature becomes excessively high.
 - j. Solid-state ground-fault protection and indication shall be provided with the VFD.
 - k. VFD shall not require external 120 volt control circuit to perform any of the functions listed herein. Any control power required shall be provided internally from the VFD.
 - l. Motor Thermal Overload Protection shall be provided with door- mounted reset button and integral adjustments for the exact motor full load amps. Motor thermal overload relay shall be mounted inside the VFD cabinet.
- M. Line Noise: The Variable Frequency Drive shall be furnished with Class H dry type isolation transformers, Class H insulation line reactors and other line noise filtering devices as required to prevent line noise from being transmitted into the AC power system. The line noise shall be no greater than 3% Harmonic Distortion and no more than a 16,400 volt-microsecond commutation notch area, in accordance with IEEE Standard 519-1981 for Special Applications. Line noise testing shall be accomplished at the jobsite with a spectrum analyzer to determine line noise levels. Line reactors or filters should be considered in sizing the VFD units to ensure that the overall power conversion efficiency does not reduce the fan capacity below that listed in the fan schedule.
- N. Efficiency Rating: Complete efficiency versus load and speed data for all VFD ratings shall be submitted and shall be no less than 95% at 100% speed and 87% at 60% speed.
- O. Factory Testing and Warranty: Each VFD shall be factory tested to insure reliability. Testing shall include component thermal cycling, logic system simulation tests and full load operation tests. The VFD shall be heat tested with power on for 50 hours at 50oC. VFD shall be furnished with manufacturer's written certification of tests conducted and shall be warranted for one full year (from date of startup) against component failure.
- P. Diagnostic Features: The VFD shall contain diagnostics to allow on-site troubleshooting of fault conditions through built-in diagnostic indicators or through a diagnostic tester. One diagnostic tester

must be included with the VFD package, to provide a functional test of each regulator card through a prewired diagnostic test port.

PART 3 - EXECUTION

3.1 GENERAL

- A. Start-up Service: Provide the services of a factory-trained service technician during startup to ensure that the VFD units have been installed and wired correctly and that the factory-recommended startup procedures are followed for each of the VFD units installed.
- B. Instructional Period: Provide one 8-hour instructional period to the Owner's maintenance personnel, scheduled at the Owner's convenience during the Warranty period, to provide instruction on the design, operation and maintenance of the Variable Frequency Drives.

END OF SECTION 23 09 25

SECTION 23 21 13 - PIPING SYSTEMS: HVAC, WATER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. Provide systems as indicated and include all offsets, fittings, sleeves and similar items required (but not indicated due to drawing scale) for complete and operable systems.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of the Division-23 and to all other applicable portions of the drawings and specifications.
- B. This section directly relates in particular to sections (which may or may not be included in this division) which describe the following:
 - 1. Valves, cocks and specialties.
 - 2. Thermometers, gauges and flow meters.
 - 3. Insulation.
 - 4. Connected equipment.

1.4 SHOP DRAWINGS

- A. Refer to the Section entitled "General Mechanical Provisions".
- B. For each pipe system submit:
 - 1. Pipe system name (chilled water, heating hot water, etc.)
 - 2. Pipe type to be used per size range including ASTM number, wall thickness, material.
 - 3. Fittings and Unions: ASTM number, class, type, material.
 - 4. Joint type
 - 5. Thread joint sealants, flange gaskets: material and rating.
 - 6. Pipe flushing procedures.
 - 7. Leakage test pressures.

1.5 INDUSTRY STANDARDS

- A. Where compliance with an industry, society or association standard is specified or indicated, certification of such compliance shall be submitted with shop drawings.

1.6 PRESSURE AND TEMPERATURE RATINGS

- A. Temperature: Unless otherwise specified, ratings shall be at 150°F for the chilled and condenser water systems and 200°F for the hot water system for all components specified herein.
- B. Pressure: Unless otherwise specified, all components must be of pressure class and rating to be recommended for operation at the maximum allowable non-shock pressure of 200 psig.

1.7 FLUIDS

A. This section covers the following fluids:

1. Chilled water.
2. Hot water.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Application: Piping systems shall be of the materials indicated.
- B. Quality and Weight: Materials shall comply with requirements and specifications of the appropriate standards of the American Society for Testing and Materials.

2.2 STEEL PIPE AND FITTINGS

- A. Pipe: Black steel, seamless or electric weld for pipe sizes two (2) inches and above, continuous weld below two (2) inches, conforming to ASTM Std. Spec. A-53 or A-120. Schedule 40 to 10"; 0.375" wall thickness for 12" and greater.
- B. Fittings:
1. General: Be wrought steel socket welded or threaded, or wrought steel butt welded, rated to match the schedule of the connected pipe.
 2. Screwed Fittings: Malleable iron, ASTM A-47. Unions shall be 250 lb. (maximum) ground joint type. All couplings, regardless of size shall be taper tapped; i.e., couplings 2 inches and smaller shipped with pipe are not acceptable for use in the piping system.
 3. Welded Fittings: Forged, seamless, black steel, long radius, conforming to ASTM Std. Spec. A-234. Weldolet fittings may be used in lieu of forged tees where branch connections are not larger than three-quarters the size of main pipe. Use groove or ridge type welding rings on all piping over 4-inch diameter. Mitre elbows, tees and reducers are prohibited.

2.3 COPPER PIPE AND FITTINGS

- A. General: Comply with ASTM A-88. Copper is allowed for pipe sizes only up to and including 4-inch diameter.
- B. Pipe and fittings (½-inch OD and less): Type L soft drawn tubing with flare fittings.
- C. Pipe and Fittings (up to 2-inch diameter): Type L, hard drawn, ASTM-B88 with wrought or cast brass solder joint fittings.

2.4 UNIONS, FLANGES AND DIELECTRIC INSULATORS

- A. Unions: Use ground joint unions on piping 1-1/2" and smaller, and flanged unions on sizes 2" and larger. Use malleable iron on steel piping black or galvanized as specified for piping. Unions in copper piping shall be brass.
- B. Flanges: Forged carbon steel, welding neck type conforming to ASTM Std. Spec. A-181 Grade 1. Flanges shall have raised face and gaskets conforming to ANSI B16.5.
- C. Dielectric Isolators:

1. Dielectric Unions: Are to be used at all junctions of copper pipe and steel equipment. Use flanged type insulated unions in piping 1-1/2" and larger with screw or solder joint connections to suit pipe and equipment. Epco, Capitol Manufacturing and Supply Co., Patrol Valve Co., or approved equal.
2. Dielectric Flanges: For pipe sizes two and one-half inches and over; Plico Products, flanged insulation sets with; phenolic retainer, nitrile rubber seal element, polyethylene sleeves and double washer sets.

2.5 PIPE NIPPLES

- A. Provide nipples of same material and weight as pipe used. Provide extra strong nipples when length of unthreaded part of standard weight nipple is less than 1-1/2".

PART 3 - EXECUTION

3.1 GENERAL

- A. Routing and Placement: Piping shall be run without traps or pockets and pitched 1" in 40' in the direction of flow. Interior piping shall be run parallel to the walls and ceilings in a neat manner and shall be offset as required to avoid interferences with structural or architectural features and other work. 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. Drawings are generally diagrammatic and do not show every bend, off-set, elbow or other fitting required in the piping for installation in the indicated location. Coordinate installation so that no conflicts or interferences are created with other piping, equipment or other work.
- B. Run all lines parallel or perpendicular to building lines and with a minimum of joints and fittings. Avoid diagonal runs where possible.
- C. Insulated Piping: For piping requiring insulation, install piping with sufficient clearances to permit proper application of the insulation.

3.2 APPLICATIONS OF PIPING SYSTEMS

- A. General: Piping systems may be installed as steel or copper systems of the materials specified. These systems may be installed as combinations of steel and copper providing the appropriate dielectric isolators, methods of joining, compliance with maximum and minimum allowed sizes, and other requirements are provided.

3.3 EXPANSION AND CONTRACTION

- A. Piping shall be installed with provisions for expansion both horizontally and vertically in all long runs including runouts from risers. Essentially the provisions shall take the form of expansion loops or expansion elbows, as indicated on the drawings; however, in certain portions, where indicated, these provisions may take the form of expansion connectors as specified in other sections.

3.4 JOINTS AND CONNECTIONS

- A. General:

1. Correctly align all pipe before joints are made.
 2. Joints in copper piping shall be made with 95-5 solder and flux.
 3. Joints and connections shall be made permanently air, gas and water tight.
- B. Welded Joints: All pipe 2-1/2" and larger shall be welded. Cut pipe square using pipe cutting tool and carefully ream pipe to remove all burrs. Bevel ends of pipe and, after carefully aligning and setting of proper weld gap, tack weld to secure pipe and fittings in true alignment. All weld shall be of sound metal with tack welds removed in advance of finish weld.
- C. Welder Certification: All welding shall be performed by welders certified in accordance with ANSI B31.1 with test conducted by the National Certified Pipe Welding Bureau or by other approved testing laboratory. Copy of certification shall be available at job sites. Welders shall show certification certificates to inspector at or prior to time welder is assigned to job. If work of welder is not satisfactory to the inspector, recertification will be required.
- D. Welding Rings: Provide welding rings for all butt welded joints.
- E. Screwed Joints: Shall be used on steel pipe two (2) inches and smaller except where flanged connections to equipment or valves are required. Cut pipe square using pipe cutting tool and carefully ream pipe to remove all burrs. Cut a complete thread, using sharp dies properly set and centered, while applying oil graphite cutting lubricant. Use non-hardening compound or tape on male threads only at each joint and tighten joint to leave not more than 3 threads exposed. Provide American Standard Thread screwed joints.
- F. Copper Tube: Ream all pipe after cutting squarely, clean outside of tube ends and inside of fittings and tin end to be soldered. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.
- G. Dissimilar Metals: Where incompatible piping system materials come in contact (except for the use of valves), isolate the two materials with dielectric isolators.

3.5 EQUIPMENT CONNECTIONS

- A. General: Make connections between any piece of equipment and any piping system in this Section of the Specifications by means of 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 two (2) inches and under and as otherwise noted below for pipe sizes over two inches.
- B. Chillers: Connections to condensers and evaporators shall be made using mechanical pipe couplings, as specified in another section.
- C. Pumps, Valves, Strainers and Other Equipment: Connections shall be made using flanges and bolt and gasket sets to suit the individual pieces of equipment and insure ease of service access.

3.6 BRANCH AND RISER ISOLATION

- A. Valves: Provide valves to isolate each riser and branch line.

3.7 PIPE SIZE REDUCTIONS AND ENLARGEMENTS

- A. Screwed bushings are prohibited, except where available space prevents use of reducing couplings. Pipe reductions on horizontal piping shall be made with eccentric reducers. Top of piping shall be flat for venting.

3.8 VALVES

- A. General: All valves, balancing cocks and similar items shall be installed in an easily accessible location. Provide access panels for all concealed valves. Where butterfly valves are used, they shall be installed between properly spaced flanges, then run to the full open position before mounting bolts are tightened in order to insure a balanced pressure on the seat and prevent distortion.
- B. Install valves or cocks in supply and return lines to each piece of equipment on piping main side of union connections.
- C. Install valves in horizontal piping with the valve stem in the vertical upright position.
- D. Install valves to provide adequate clearance to permit easy operation of the valve hand wheel and permit servicing of the valve packing.

3.9 AIR VENTS AND DRAINS

- A. Vents and drains shall be provided where shown on the drawings, and at all high and low points, respectively, in the system. Provide gate valves (3/4") with hose thread connector (adapter) at each vent and drain point.

3.10 INSTRUMENTATION AND SPECIALTY ITEMS

- A. Thermometers, gauges, gauge cocks, gauge valves, instrument wells, flow stations, flow switches, control valves and similar items which may be specified in other Sections shall be installed complete, including the provision of standard pipe fittings as may be required, as work of this Section. Installation of these items shall be in strict accordance with the manufacturer's installation instructions.

3.11 FLOW INDICATING AND/OR BALANCING VALVES OR METERS

- A. Install flow indicating balancing valves where shown on drawings. The locations shown on drawings or otherwise indicated are diagrammatic in nature and are intended basically to show the requirement for flow measurement and shut-off relative to a specific piece of equipment or portion of the system and not in the exact physical location of the device. The exact physical location shall be determined using field measurements relating to upstream and downstream clearances. Install in accordance with manufacturer's recommendations including increases or decreases in pipe size at points of installation together with minimum recommended lengths of straight run pipe before and after points of installation. Balancing shall be done as work of the section describing test and balance.

3.12 PRESSURE RELIEF VALVES

- A. Install pressure relief valves where specified or indicated on the drawings. Pipe to spill over floor drain or service sink.

3.13 TESTS

- A. Prior to insulating and concealing the pipe, apply a water pressure test to all parts of the systems before equipment is connected. Use a hydrostatic pressure of not less than 100 psig or 150% of system operating pressure, 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. 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 approved. Make repairs of defects that are discovered as a result of inspection or tests with new materials. Caulking of screwed joints, cracks or holes will not be accepted. Repeat tests after defects have been eliminated.
- C. Complete all field testing prior to insulation, wrapping and/or backfill.
- D. Submit certified test reports when all pipe has been leak tested.

3.14 FLUSHING AND CLEANING

- A. After final testing, thoroughly flush each piping system 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.
- B. After flushing, thoroughly clean each piping system with appropriate cleanser to remove oil, grease, lacquer, etc. Thoroughly flush each system with clean water after cleaning.
- C. Also see section describing water treatment systems for HVAC Systems.

3.15 PROTECTION

- A. Paint all uninsulated piping underground except cast or ductile iron or PVC with two coats of asphaltic paint. (Manual wiping is not acceptable.)
- B. Wrap pipe that touches metal or is exposed to masonry with a layer of 6 mil polyethylene film or 15 lb. felt.
- C. Coat all exposed threads on galvanized steel pipe after assembly with two coats of zinc chromate. Remove pipe thread lubricants prior to applying paint.

END OF SECTION 23 21 13

SECTION 23 31 00 - DUCTWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. Provide complete duct systems as indicated. Systems shall include, but not be limited to, the following: outside air, exhaust air, and air conditioning supply and return air duct systems as shown on drawings. Drawing scales prohibit the indication of all offsets, fittings, and like items; however, these items shall be installed as required for the actual project conditions at no change in contract price.
- B. Items Included: This section generally includes, but is not limited to, the following major items:
 - 1. Low pressure sheet metal ductwork.
 - 2. Acoustical thermal duct liner.
 - 3. Low pressure fiberglass ductwork.
 - 4. High pressure sheet metal ductwork, round and flat oval.
 - 5. High pressure sheet metal ductwork, rectangular.
 - 6. Low pressure flexible ducts.
 - 7. High pressure flexible ducts.
 - 8. Other special duct systems.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions" for related requirements. Refer to other sections of Division 23 and to other applicable portions of the Drawings and Specifications.
- B. This section is directly related in particular to sections (which may or may not be included in this division) which describe the following:
 - 1. Sections describing air handling equipment and fans.
 - 2. Air distribution devices.
 - 3. Terminal units.
 - 4. Duct system accessories.
 - 5. Insulation.
- C. Coordinate shop drawings, ordering, delivery, and placement of all items affecting the duct systems including, but not limited to, the following items: air handling units, exhaust fans, supply fans, sound attenuators, duct mounted coils, access panels, air distribution devices, fire dampers, outside air louvers, hoods, filters, roof curbs, structural framing, roof construction, roofing, and the work of all trades to insure an orderly and timely progression of the work. Refer to the requirements of Section entitled "General Mechanical Provisions".
- D. Refer to other sections which may describe additional sound attenuation measures which may relate to this section.

1.4 SHOP DRAWINGS

- A. Refer to Section entitled "General Mechanical Provisions". Include complete data as applicable to this project on: all prefabricated duct and fittings; duct liner including mechanical fasteners and adhesives; duct sealing materials; duct joining and seaming methods; and all other items. Prepare and submit for

LINE 1
LINE 2

NO.

review completely detailed shop drawings of supply, return, and outside air ductwork from any or each air handling unit through its transitions, bends and elbows until such ducts are extended beyond the air handling unit equipment area and/or congested areas.

B. For each duct system submit:

1. Duct system name with corresponding equipment it serves (AHU-1 SA, EF-1, etc.)
2. Duct material.
3. Pressure class.
4. Duct gauge along with transverse joint type, length, and reinforcement rigidity class and designated joint T number per SMACNA.
5. Intermediate reinforcement spacing and rigidity class.

C. Duct systems with equal pressure class and duct material requirements may be grouped together for submittal purposes (AHU-1 SA and AHU-2 SA, AHU-1 RA and AHU-2 RA, etc.).

1.5 OTHER REQUIREMENTS

A. Provide all ductwork and components thereof in accord with manufacturer's recommendations. All ductwork dimensions indicated are nominal free clearance internal dimensions which do not include insulation thickness.

1.6 DEFINITIONS

A. "SMACNA" means "Sheet Metal and Air Conditioning Contractors National Association, Inc."

B. Low Pressure Ductwork: Any and all ductwork conveying air or other gases at velocities less than 2000 fpm and pressure class construction equal to or less than 2.0 inches wg. This ductwork may also be referred to in these specifications as "Low Velocity Ductwork". SMACNA "HVAC Duct Construction Standards, Metal and Flexible", Third Edition, 2005, shall govern construction of this ductwork unless otherwise specified.

1. Where and if fiberglass ductwork is specified, it shall be considered only for low pressure classification use and shall be constructed in accord with SMACNA "Fiberglass Glass Duct Construction Standards", Seventh Edition, 2003.

C. High Pressure Ductwork: Any and all ductwork conveying air or other gases at velocities equal to or greater than 2000 fpm or pressure class construction greater than 2.0 inches wg. This ductwork may also be referred to in these specifications as "High Velocity Ductwork" or "Medium Pressure Ductwork", but shall be considered, in either terminology, to fall within pressure/velocity class (PV/C designation) 3 to 10. SMACNA "HVAC Duct Construction Standards, Metal and Flexible", Third Edition, 2005, shall govern construction of this ductwork unless otherwise specified.

1.7 PRESSURE/VELOCITY CLASSIFICATIONS

A. Pressure and velocity classifications (hereinafter called "P/VC") for ducts are defined as follows:

	SMACNA	Static	Positive	SMACNA	Maximum
P/VC	Pressure	Pressure	or	Velocity	
Design.	Class	Rating	Seal	Pressure Class	(fpm)
			Pressure		

10	High	10"	+	A	2000 up
6	Medium 6"		+	A	2000 up
4	Medium 4"		+	A	4000 dn
3	Medium 3"		+ or -	A	4000 dn
2	Low	2"	+ or -	A	2500 dn

B. See Part 3, EXECUTION, of this section for duct sealing requirements.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials shall comply with current SMACNA standards.

B. ASTM: Unless otherwise specified, ASTM material specifications applicable are:

<u>Material</u>	<u>Type</u>	<u>ASTM Number</u>
Galvanized steel	G90	A653
Stainless steel	304L,316	A240 and A480
Cold rolled steel	20-28 ga.	A366
Cold rolled steel	18 ga.	A619
Aluminum	3003 H-14	B09 and B209

C. Special Materials, Gauges and Construction:

1. Special Materials: Where special duct material other than galvanized steel is required, such duct material (e.g., fiberglass, stainless steel, plastic such as polyvinylchloride, etc.) shall be specifically indicated.
2. Gauges: Gauges indicated in this section are for galvanized steel. Where greater or lesser gauges are specifically indicated for a sheet metal material other than galvanized steel, provide the indicated gauge. Comply with the SMACNA construction standard covering the required material if no gauge is given.
3. Construction: Comply with indicated special requirements (i.e., such as welding, soldering, etc.) where application requires.

2.2 LOW PRESSURE SHEET METAL DUCTWORK

A. Material: Prime quality forty-eight inch wide resquare tight coat galvanized steel conforming to the requirements of ASTM A-653 and/or A-527 as applicable to the intended use.

B. Construction:

1. Construct to comply with the pressure/velocity classification(s) indicated.
2. Use rectangular or round as indicated on drawings.
3. Reinforcing, Cross Breaking, Seams, Joints: Be in accord with latest SMACNA construction standard for low pressure sheet metal duct.
4. Gauge: As required by SMACNA for the dimensions and pressure/velocity classification involved.

LINE 1
LINE 2

NO.

5. Seam construction for round ductwork: Spiral lock-seam (SMACNA Type RL-1) for all pressure/velocity classifications. Snap-lock may not be used.

C. Insulation:

1. Rectangular rigid sheet metal ductwork: shall be internally lined with acoustical thermal duct liner if so designated.

2.3 ACOUSTICAL THERMAL DUCT LINER

- A. Line ductwork where indicated. Dimensions indicated are net inside dimensions. Liner shall be 1-1/2 inch thick, Flexible Elastomeric Duct Liner: preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B. Duct liner shall comply with requirements of NFPA 90A as to flame spread and smoke developed ratings. Duct liner shall be factory treated with antimicrobial/antibacterial treatment to prevent formation & growth of bacteria.
- B. Acceptable Manufacturers: Aeroflex, Armacell, Ductmate Industries, or K-Flex USA.
- C. Attachment: Attach to the interior of sheet metal as required by manufacturer's installation instructions.

2.4 LOW PRESSURE FIBERGLASS DUCTWORK

- A. Material: One inch (1-1/2") thick glass fiber ductboard, meeting requirements of NFPA 90A and shall have a factory applied UL 181, Class 1 air duct listing label. Board shall be faced with aluminum foil. Inside surface shall be factory treated for microbial bacterial growth prevention.
 1. Fabricated from or lined with non-corrosive, non-hygroscopic, permanently odorless, resilient, long staple, fabric grade glass fibers preformed into semi-rigid or rigid board.
 2. Flexural rigidity rating of 800EI per ASTM test number D 1037 64 where neither width nor depth or duct exceeds 48 inches.
 3. Flexural rigidity rating of 1400EI per ASTM test number D 1037 64 where width or depth exceeds or equals 48 inches.
 4. Non-erosive when conveying air at velocities equal to or less than 2000 fpm.
 5. Approved, fire retardant, moisture sealing, factory-applied jacket made of kraft paper and 2 mil minimum thickness aluminum foil.
 6. Maximum thermal conductivity of 0.23 at 75°F mean temperature.
- B. Fabrication: Ductwork fabrication shall be in accordance with SMACNA Fibrous Glass Manual, Duct Construction Standards, and current manufacturer's literature on approved fabrication methods.
- C. Closure Systems: Closure systems shall be as specified by manufacturer of the ductboard to maintain the UL Class 1 duct label. Provide closure of all joints using 9/16" outward clinch staples,

approximately two inches (2") wide pressure sensitive tape. Use factory molded male-female joints wherever possible. Use appropriate UL and SMACNA approved tapes.

- D. Acceptable Products: Johns-Manville Micro-Aire Type 475 or 800 as applicable; Owens Corning Fiberglass Type 800FR or 1400FR as applicable; or approved equal.

2.5 HIGH PRESSURE DUCTWORK, ROUND AND FLAT-OVAL

A. General:

1. Comply with current SMACNA standards.
2. Factory fabricated portions shall be made by United McGill, Semco or equal.

B. Straight Conduit: Galvanized steel unless otherwise indicated for a specific application.

1. Seam construction: Spiral lock-seam (SMACNA Type RL-1) for all pressure/velocity classifications. Snap-lock may not be used.

C. Fittings:

1. Material: Same as connecting duct system.
2. Configuration: Standard design as manufactured by United McGill, Semco or equal.

3. Elbows:

- a. General: All mitered elbows must be vanned.
- b. Round: 5-inch diameter and larger shall be five-section construction; less than 5-inches diameter shall be die-formed.
- c. Flat-oval: Five-section construction.
- d. Hard turn oval elbows shall have vanes as follows:

<u>Equivalent diameters</u>	<u>Number of Vanes</u>
10" through 14"	3
15" through 19"	4
20" through 60"	5
Over 60"	12" spacing

4. Vanes: Be minimum 20 gauge and limited to 24 inches of unsupported length. The leading edge of all vanes in duct exceeding 20 inch size will be hemmed with a 1/2 inch fold back.
5. Divided Flow Fittings: All divided flow configurations are to be furnished as separate fittings. Tap covers welded into spiral duct sections are not acceptable. All tees, crosses and laterals up to an including 12" diameter tap size, will have a minimum 3/8" radius rounded entrance into the tap, produced by machining, press forming, or hand grinding to a smooth entrance. The entrance will be free of projections, weld buildups, burrs or irregularities. All fittings will have continuous welds along all seams.
6. Tees and Crosses: All tees and crosses shall be the spun conical type with branch entrances through 12" size, to be rounded laminar flow as noted above.
7. Connections: Connections of conduit to fittings shall be made with a synthetic rubber sealing compound conforming to NFPA 90A as to flame spread and smoke developed ratings and mechanically fastened with drive or twist screws, and all joints tested in accordance with test

LINE 1
LINE 2

NO.

procedure described hereinafter. Raychem TDB duct sealing bands may be used in lieu of the sealing compound. Connection between conduit and terminals shall be made with a maximum of 48" of flexible duct. Runout connections shall be assembled in same manner as conduit and fittings.

- D. Gauge: Minimum gauge as follows (gauges are for round and flat-oval duct with spiral lock-seam construction unless otherwise indicated):

1. Round duct (galvanized steel):

Diameter (Inches)	Gauge	Alternate Gauge(2)
3 thru 8	26	24
9 thru 14	26	24
15 thru 26	24	22
27 thru 36	22	20
37 thru 50	20	20
51 thru 60	18	18
61 thru 84	18(1)	16

(1) Must be 16 ga. when static pressure is negative.

2. Flat-oval duct (galvanized steel):

Major Dimension (Inches)	Gauge
0 thru 24	24
25 thru 36	22
37 thru 48	22
49 thru 60	20
61 thru 70	20
71 and up	18

- E. Fittings:

1. Round duct: Same as duct unless otherwise recommended by manufacturer.

2. Flat-oval duct:

Major Dimension (Inches)	Gauge
0 to 24	20
25 to 36	20
36 to 48	18
49 to 60	18
61 to 70	16
71 and up	16

2.6 HIGH PRESSURE DUCTWORK, RECTANGULAR

A. General:

1. Airtight and structurally stable at maximum system operating pressure.
2. Any welding shall be continuous and corrosion resistant.
3. Galvanized sheet steel unless otherwise indicated for a specific application.
4. Reinforced and supported to neither cause nor convey any objectionable vibrations.
5. Be in accordance with latest SMACNA construction standard for high pressure ductwork.

B. Turning Vanes: Adequate rigidity and strength to be completely flutterproof. Airfoil, permanently fixed type constructed of galvanized steel or aluminum with sound attenuating fiberglass inner liner with open protective metal facing. Quantity in each elbow in accordance with manufacturer's recommendations. Airsan Acoustiturn as made by Air Filter Corporation, 4554 W. Woolworth Ave., Milwaukee, Wisconsin 53218 or equal.

2.7 DOUBLE WALL DUCTWORK, RECTANGULAR, ROUND, FLAT OVAL, LOW AND HIGH PRESSURE

A. Manufactures: United McGill, Linx (formerly Lindab), Sheet Metal Connectors, Semco, AccuDuct

B. General construction is specified in respective sections. Flame spread and smoke developed ratings shall comply with NFPA 90A. Double walled with galvanized solid sheet steel outer wall and galvanized perforated sheet steel inner wall. Gauge and reinforcement based on specified pressure class. Two inch thick annular space between inner and outer walls uniformly packed with fiberglass insulation with effective thermal conductivity of 0.27 BTUH per sq. ft. separated from air stream using mylar film. Coat insulation with antimicrobial coating.

2.8 HIGH PRESSURE DUCT RELIEF AND ACCESS DOORS

A. Provide suitable size for access to heaters, dampers and other equipment installed in duct, and at other points indicated on drawings. Size shall be as listed by paragraph above and compatible with duct size but not smaller than 8"x12". Doors shall be 24 US gauge galvanized steel hinged to a 24 gauge galvanized mounting frame and for insulated duct shall be double panel construction with 1/2 inch rigid insulation material between metal panels. Doors shall be United Sheet Metal Type AR or an approved equal.

2.9 LOW PRESSURE FLEXIBLE DUCTS

A. General:

1. The inclusion of flexible ducts in this specification shall not be construed as approval of use on the project unless specifically shown on the Drawings.
2. Where used, provide in factory finished lengths not in excess of lengths required to make kink-free connections with minimum air pressure drop.

B. Insulated flexible ducts: Flexible duct shall be factory-fabricated preinsulated type with seamless vapor barrier. Duct shall bear UL 181 Class 1 Air Duct label and shall comply with NFPA 90A and 90B. Fiberglass insulation nominal 1" thickness with thermal conductance of 0.23 BTU/hr-ft²-°F maximum at 75°F mean temperature. Flexible duct shall have an operating range of negative 2" w.g. to positive 10" w.g. Core shall be continuous and consist of aluminized mylar laminated to corrosion resistant steel wire helix. Vapor barrier perm rating shall be 0.17 maximum per ASTM E96-A. Maximum working velocity shall be 4000 FPM. Flexible duct shall be Flexmaster Type 1M, Thermaflex M-KC, Atco #036 or approved equal.

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C. Un-insulated flexible ducts, steel: Flexible ductwork shall be constructed of all metal one ply hot-dipped galvanized steel, closely corrugated for strength and flexibility, with seams interlocked, folded flat, and knurled to insure tightness. Duct shall be listed as #UL181 "Flexible Air Duct", Class 1, and NFPA 90A. Products shall be Flexmaster Type NI-TL, Clevaform Type GS or approved equal.

D. Round branch take-off fittings for flexible duct:

1. Round duct branch take-off fitting shall be made of galvanized sheet metal designed to assure minimum air loss at the take-off. The fittings shall be of the conical converging type or as shown on duct installation detail to reduce the pressure drop through the fittings. Provide a raised bead on the throat of the fitting to assure a tight positive connection. Products shall be Flexmaster Model CBD-BO3 2000G series or approved equal.
2. Provide each fitting with the following:
 - a. Lockable quadrant damper.
3. Provide these conical type fittings at all connections between rigid sheet metal duct and flexible duct at the upstream end of the flexible duct.

2.10 HIGH PRESSURE FLEXIBLE DUCTS

A. Meet all requirements for low pressure flexible ducts except be recommended by manufacturer for high pressure application and meeting the pressure class specified for the system.

2.11 FLEXIBLE STAINLESS STEEL EXHAUST DUCTS

A. Flexible ducts shall be factory fabricated uninsulated all metal type. Ducts shall be spiral flexible lockformed from type 302 stainless steel strips of 0.18" to 0.20" minimum thickness. Ends of individual duct lengths shall be plain for connection to ductwork collars and for securing to collars with stainless steel band clamps. Flexible duct lengths shall suit the usage and purpose requirements of the devices served by the flexible ducts. Flexible ducts shall have an operating range of minus 3.0" w.g. to plus 3.0" w.g. Maximum working velocity shall be 4000 FPM. Minimum allowable inside bend radius shall be no greater than four and one-half duct diameters. Flexible ducts shall be Universal Metal Hose Company "U-120", Flexmaster Type SS-NI-TL, or approved equivalent.

2.12 RIGID STAINLESS STEEL EXHAUST DUCTS

A. Food Service Equipment Exhaust Ducts: Exhaust ducts which are intended to remove air laden with grease vapor and/or water vapor from cooking ranges, fryers, ovens, dishwashers, and similar cooking equipment shall be as follows:

1. Construct ductwork and vertical exhaust duct stackheads of stainless steel ANSI type 304, mill finish, 16 gauge minimum.
2. Exposed locations shall have No. 4 polished finish.

B. Exhaust Ducts for Laboratory Fume Hoods, ductwork conveying fumes, and Ethylene Oxide Sterilizers:

1. Construct ductwork and vertical exhaust duct stackheads of stainless steel ANSI type 302, mill finish.
2. Ductwork in exposed locations shall have No. 4 polished finish.

2.13 OTHER SPECIAL DUCT SYSTEMS

A. Perchloric Acid Fume Hood Exhaust Ducts and Wash-Down Systems:

1. Perchloric acid fume hood exhaust ductwork shall be type 316 stainless steel, flanged and gasketed. Ductwork in exposed locations shall have No. 4 polished finish.
2. Provide two washdown systems for each perchloric acid fume hood system. One washdown system shall serve the hood, and the other system shall serve the exhaust ductwork and fan system.
3. Washdown systems shall include type 316 stainless steel full-jet spray nozzles with stainless steel piping to the centerline of each duct with exterior duct couplings and all interconnecting piping, including water supply and drain piping. The washdown systems shall provide complete coverage including fume hoods, ductwork, elbows, fans and stacks. All controls, valves and appurtenances shall be provided for proper operation of the systems.
4. All perchloric acid fume hood exhaust ductwork, including exhaust fans and stacks, shall be fabricated and installed by the fume hood manufacturer. All perchloric acid fume hood exhaust washdown and drain systems shall be designed, fabricated, and installed by the fume hood manufacturer.

PART 3 - EXECUTION

3.1 GENERAL

- A. All duct systems shall be free of noise, chatter, vibration and pulsation under all conditions of operation. Remove, replace or reinforce as directed by the Architect/Engineer if necessary to correct such conditions.
- B. If field conditions are determined to exist which would limit the guarantee of air delivery or system performance, due notice in writing shall be submitted to the Architect/Engineer of such conditions prior to starting fabrication.
- C. Properly support and align ductwork. Ducts to be free of sag and bulge. 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.
- D. Where it is necessary that ducts be divided due to pipes or other obstructions which must pass through these ducts, the Contractor shall, at locations as noted or directed, provide air-stream deflectors in the duct and the duct shall be increased in size to maintain equivalent area around deflectors. Such changes shall be in accord with standard SMACNA details and shall be shown on Contractor's As-Built Drawings.
- E. Interior of ductwork visible through registers, grilles, or diffusers shall be painted flat black.
- F. Do not route ductwork through transformer vaults and electrical equipment spaces and enclosures.
- G. Construct all ductwork and accessories in accord with the latest indicated editions of applicable SMACNA construction standards. Sheet Metal and Air Conditioning Contractors' National Association.
- H. Streamline all ductwork to the full extent practical and equip with proper and adequate devices to assure proper balance and quiet draftless distribution of indicated air quantities.

LINE 1

NO.

LINE 2

- I. Protect all ductwork and system accessories from damage during construction until Architect/Engineer's final acceptance of project. Keep ductwork capped when work is complete for the day or when duct is not being worked on or added to. Use of polyvinyl (VISQUEEN) with duct tape wrap is an adequate measure as long as it is secure with no openings or tears in product.
- J. Prior to ductwork fabrication, verify if all ductwork as dimensioned and generally shown will satisfactorily fit allocated spaces. Take precautions to avoid space interferences with beams, columns, joists, pipes, lights, conduit, other ducts, equipment, etc. Notify Architect/Engineer if any spatial conflicts exist, and then obtain Architect/Engineer's approval of necessary routing. Make any such necessary revisions at no additional cost.
- K. Carefully correlate all duct connections to air handling units and fans to provide proper connections, elbows and bends which minimize noise and pressure drop.
- L. Provide all curved elbows with radius ratios of not less than 1.5 unless otherwise shown or approved by Architect/Engineer. Provide all mitered elbows with turning vanes.
- M. Properly suspend all ductwork so that no objectionable conditions result (such as vibration, sagging, etc.).
- N. Coordinate any and all 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.
- O. If necessary where ducts interface and have different types of insulation, provide transitions so that internal free-clear dimensions of duct remain unchanged.
- P. Install horizontal low pressure ductwork at a level which maximizes length of any vertical, rectangular or round rigid duct connections to rectangular diffuser necks; however, such vertical duct connections are not required to be over 24 inches in length.
- Q. Make connections from any low pressure ductwork to terminal units (fan terminal units, variable volume boxes, etc.) with appropriate lengths of flexible duct unless other type of connection is indicated.
- R. Install all flexible round duct without kinks or similar obstructions so that pressure drop is minimized. Cut and remove excess lengths as necessary.
- S. Install horizontal rigid ductwork as high as practical above suspended ceilings so that movable light fixtures may be relocated without interference to meet any future partition relocation requirements.
- T. Insulated Duct: Where ducts will be insulated, make provision 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 finished shall be mounted on duct.

3.2 LOW PRESSURE SHEET METAL DUCTS

- A. If width or height of rectangular duct exceeds 12 inches, cross break or roll a cross bead in panels to increase stiffness; otherwise, use two gages heavier steel.

- B. Provide corner closures. Longitudinal seams and transverse joints shall be flat and smooth inside. Make slip joints in direction of air flow. See governing SMACNA manual for transition requirements.
- C. Fabricate offsets, turns and elbows with centerline radius equal to 1-1/2 times diameter when possible. No mitered offsets will be allowed. Provide double thickness turning vanes to assist in smooth flow of air in square elbows or elbows with centerline radius less than duct width or diameter.

3.3 FIBERGLASS DUCT

- A. General: Fiberglass duct is not allowed on the project unless specifically shown on the Drawings.
- B. Provide all reinforcement, bracing, suspension, workmanship and construction details for this ductwork and its accessories in strict accord with the recommendations of the Sheet Metal and Air Conditioning Contractors' National Association Fibrous Glass Duct Construction Standards or in accord with the manufacturer's recommendations, whichever is more stringent. Completed duct system(s) shall be stable and airtight at 2 inches w.g. internal static pressure. Comply with the reinforcement schedule for rectangular fiber glass air ducts as published in the SMACNA Standard.
- C. Entirely comply with NFPA Bulletin 90A and be Class I by UL-181.
- D. Miter all longitudinal corners (except seams) with jacket undisturbed.
- E. Provide ship lap construction with 1-1/2 inch minimum tape overlap on all sides of all longitudinal seams and transverse joints.
- F. All joints shall be fiber glass tape and mastic providing a UL-181 Duct Systems Class I rating.
- G. Round cross-section ducts shall be factory molded.
- H. Square and rectangular ducts shall be shop or field fabricated from flat ductboard.
- I. Metallic duct reinforcement support, and duct heater sleeves shall be galvanized steel.
- J. Fabricate offsets, turns and elbows with centerline radius equal to 1- 1/2 times diameter when possible. No mitered offsets will be allowed. Provide double turning vanes to assist in smooth flow of air in square elbows or elbows with centerline radius less than duct width or diameter.
- K. Taped joints on fiber glass ductwork shall be made by first taping the joint, then stapling through the tape on both sides of the joint interface, and then adding another layer of tape over the stapled and taped joint. Staples shall be in pairs with one staple on each side of the joint interface and with a distance between staple pairs of not greater than 3 inches as measured around the perimeter of the taped joints. Staples shall be minimum 1/2" x 1/2".

3.4 HIGH PRESSURE DUCTWORK

- A. In addition to other requirements, this ductwork shall be as follows:
 - 1. Any welds shall be continuous and corrosion resistant.
 - 2. Reinforced and supported to cause and/or to convey no objectionable vibrations.
 - 3. All seams and joints permanently sealed and joined in strict accordance with the manufacturer's recommendations.
- B. Conical Tees: Make all branch duct take-offs and all connections to flexible duct supplying air to terminal units with conical tees.

LINE 1
LINE 2

NO.

3.5 LOW PRESSURE FLEXIBLE DUCTS

- A. Flexible ducts shall not be used unless specifically indicated on drawings.
- B. If flexible duct is indicated for use on this project, it must comply with the following requirements.
 - 1. The extent of the use of flexible ductwork shall be limited to that shown on the drawings.
 - 2. Flexible duct installation shall be per SMACNA Flexible Duct Installation Standards, and manufacturers latest printed instructions, whichever is stricter. In addition the following shall apply:
 - a. Flexible duct between rigid duct and diffusers shall be a MAXIMUM of 6 feet in length and shall be fully extended with a maximum equivalent of (2) 90 degree bends (no bend shall be made with centerline radius of less than one duct diameter). No additional flexible duct shall be provided for future terminal device relocation unless otherwise specified.
 - b. 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.
 - c. Hanger or 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. Narrower hanger material may be used in conjunction with a sheet metal saddle which meets the foregoing specifications. This saddle must be formed to cover one-half the circumference of the outside diameter of the flexible duct and must be rolled to fit neatly around the lower half of the duct's outer circumference.
 - d. Factory installed suspension systems integral to the flexible duct are an acceptable alternative hanging method when manufacturers recommended procedures are followed.
 - e. Hangers shall be adequately attached to the building structure (not pipe, conduit, etc.).
 - f. To prevent tearing of vapor barrier, 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 barrier may be repaired with approved tape. If internal core is penetrated, replace flexible duct or treat as a connection.
 - 3. Terminal devices connected by flexible duct shall be supported independently of the flexible duct.

3.6 HIGH PRESSURE FLEXIBLE DUCTS

- A. Meet all the requirements for low pressure flexible ducts.

3.7 FLEXIBLE STAINLESS STEEL EXHAUST DUCTS

- A. Flexible stainless steel ducts shall not be used unless specifically indicated on drawings.
- B. If flexible stainless steel duct is indicated for use on this project, it must comply with the following requirements.
 - 1. The extent of the use of flexible ductwork shall be limited to that shown on the drawings.

2. Flexible duct installation shall be per SMACNA Flexible Duct Installation Standards, and manufacturers latest printed instructions, whichever is stricter. In addition the following shall apply:
 - a. Flexible duct between rigid duct and terminal devices shall be fully extended with a maximum equivalent of (2) 90 degree bends (no bend shall be made with centerline radius of less than one duct diameter).
 - b. 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.
 - c. Hanger or 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. Narrower hanger material may be used in conjunction with a sheet metal saddle which meets the foregoing specifications. This saddle must be formed to cover one-half the circumference of the outside diameter of the flexible duct and must be rolled to fit neatly around the lower half of the duct's outer circumference.
 - d. Factory installed suspension systems integral to the flexible duct are an acceptable alternative hanging method when manufacturers recommended procedures are followed.
 - e. Hangers shall be adequately attached to the building structure (not pipe, conduit, etc.).
 - f. Provide collars on rigid duct at flexible duct connection points. Connect flexible ducts to rigid ducts and to terminal devices and secure with stainless steel band clamps, or otherwise in accordance with flexible duct manufacturer's instructions.
 - g. 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. If duct is penetrated, replace flexible duct or treat as a connection.
3. Terminal devices connected by flexible duct shall be supported independently of the flexible duct.

3.8 RIGID STAINLESS STEEL DUCT

- A. In addition to SMACNA recommendations and other requirements, rigid stainless steel duct systems shall comply with the following:
 1. All joints and seams shall be made with continuous welds. Ductwork shall be liquid tight and gas tight.
 2. Hangers and supports in finished areas shall be of same material as ductwork.
 3. Joints in laboratory hood exhaust duct may be flanged and gasketed only at air valve connection.
 4. Food Service Equipment Exhaust Ductwork:
 - a. Kitchen exhaust ductwork of stainless steel shall be installed in accordance with NFPA 96 Standard for removal of smoke and grease laden vapors from commercial cooking equipment.
 - b. Install horizontal stainless steel kitchen exhaust ductwork with a minimum slope of 1-inch per foot.
 - c. Provide access panels of suitable size at 3'-0" centers minimum and at each change of direction for cleaning purposes.

LINE 1
LINE 2

NO.

- d. Changes in Shape and Direction: Construct all changes in shape or direction in such a manner as to prevent the formation of any traps or pockets which might collect grease.
- e. Cleanout Openings: Provide an opening in each exhaust duct at each change in direction of duct for the purposes of inspection and cleaning. Openings shall be at the sides and large enough to permit cleaning. In horizontal sections the lower edge of the opening shall be not less than one and one-half inches from bottom of the duct. Covers shall be constructed of the same material and thickness as the duct and shall be grease tight when in place.
- f. Standards: Comply with latest SMACNA construction standard which covers this type of duct system.

3.9 POLY-VINYL-STEEL DUCTS

- A. In addition to the requirements for low pressure sheet metal ducts and other requirements specified herein elsewhere in this section, poly-vinyl-steel duct systems shall comply with the following:
 - 1. All ducts and fittings shall be constructed in accordance with manufacturer's recommendations and specifications.
 - 2. All exposed raw edges shall be covered completely with poly-vinyl-steel sealant.
 - 3. Apply aerosol poly-vinyl-steel coating compound to any scratched surfaces.
 - 4. All sheet metal screws and fasteners shall be stainless steel.

3.10 DOUBLE WALL DUCTWORK

- A. Unless otherwise stated, provide double wall ductwork in public areas outside of mechanical, electrical, or equipment rooms where ductwork is exposed and duct system is specified to be insulated.

3.11 OTHER SPECIAL DUCT SYSTEMS

- A. Roof Mounted Exterior Ductwork:
 - 1. Support all roof-mounted exterior ductwork with angle iron bracing firmly secured to roof construction and in such a manner to maintain watertight integrity of specified roofing system. All ductwork roof penetrations and ductwork support roof penetrations shall also be provided in such a manner to maintain watertight integrity of specified roofing system. Refer to structural drawings for all structural attachments and architectural drawings for flashing requirements.
 - 2. All roof-mounted exterior ductwork shall be completely and permanently weatherproof including connections at air conditioning units, roof penetration points and all other points.
 - 3. Submit shop drawings completely describing all supporting systems for this external ductwork.
- B. Perchloric Acid Fume Hood Exhaust Ductwork and Wash-Down System:

1. The fume hood manufacturer shall fabricate and install all perchloric acid fume hood exhaust ductwork, including exhaust fans and stacks. The ductwork shall be routed as shown on the drawings, shall be fabricated and installed by the mechanical contractor.
2. The fume hood manufacturer shall design, fabricate and install all perchloric acid fume hood exhaust washdown and drain systems. The respective washdown water supply and drain piping systems shall be connected to domestic water supply and drain connections provided at the locations shown on the plumbing drawings.

3.12 MISCELLANEOUS DUCT SYSTEM COMPONENTS

- A. Spin-In Take-Off Fittings: Install around duct branch takeoff fittings according to manufacturer's installation instruction. Additionally seal fitting to rectangular duct with a thin bead of mastic sealant.

3.13 HANGERS AND SUPPORTS

- A. General: Comply with latest applicable SMACNA construction standard. Where sprayed fireproofing occurs, install hangers before application of such treatment and withhold installation of ducts until after application.
- B. Supports: Vertical risers and other duct runs where the method of support specified above is not applicable shall be supported by substantial angle brackets designed to meet field conditions and installed to allow for duct expansion.
- C. Fasteners: Secure hangers to steel beams or metal deck with beam clamps or drop through connections from the metal or concrete deck.

3.14 CHANGES IN SHAPE OR DIMENSION

- A. Where duct size or shape is changed to effect a change in area, the following shall apply:
 1. Where the area at the end of the transformation results in an increase in area over that at the beginning, the slope of the transformation shall not exceed one inch in seven inches.
 2. Where the area at the end of the transformation results in a decrease in area from that at the beginning, the slope of the transformation may be one inch in four inches, but one inch in seven inches is preferable, space permitting.
 3. The angle of transformation at connections to heating coils or other equipment shall not exceed thirty degrees from a line parallel to the air flow on the entering side of the equipment, nor fifteen degrees on the leaving side. The angle of approach may be increased to suit limited space conditions when the transformation is provided with vanes approved by the Architect/Engineer.

3.15 CHANGES IN DIRECTION

- A. Changes in direction shall be basically as indicated on the drawings and the following shall apply:
 1. Supply, Return and exhaust duct turns of ninety degrees in low pressure duct shall be made with mitered elbows with closely spaced turning vanes designed for maintaining a constant velocity through the elbow unless radius elbows are indicated in which case they shall be constructed with a turning radius one and one-half (1-1/2) times the width (with width considered as the dimension in the plane of the turn) as measured to the duct centerline.

LINE 1
LINE 2

NO.

2. Tees in low pressure duct shall conform to the design requirements specified hereinbefore for elbows.
3. Branch take-offs in low pressure supply duct shall be made with extractors or splitter dampers, as indicated, in square take-offs.
4. In high pressure duct, branch take-offs and connections to flexible duct supplying air to terminal units shall be made with conical taps.

3.16 IMPROPER MATERIALS OR CONFIGURATION

- A. If ductwork materials or ductwork configurations are installed which do not meet these specifications, Contractor shall remove such ductwork and replace with materials or configurations which are acceptable. Any delay in job progress will be the responsibility of the Contractor.

3.17 OTHER REQUIREMENTS

- A. Insulated Duct: Where ducts will be insulated, make provision 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 finished shall be mounted on duct.
- B. Control Devices: Properly install all control related devices which are part of the duct systems. See Section(s) describing control systems.

3.18 SEALING OF DUCTS

- A. Duct seal classes are as follows:
 1. Seal class "A": Seal all transverse joints, longitudinal seams and duct wall penetrations. Use for all P/VC unless otherwise indicated.
- B. Where sealing is required it shall mean the following:
 1. The use of adhesives, gaskets, tape systems or combinations thereof to close openings in the surface of the ductwork and field-erected plenums and casings through which air leakage would occur; or
 2. The use of continuous welds;
 3. The prudent selection and application of sealing methods by fabricators and installers, giving due consideration to the designated pressure class, pressure mode (positive or negative), chemical compatibility of the closure system, potential movement of mating parts, workmanship, amount and type of handling; cleanliness of surfaces, product shelf life, curing time and manufacturer-identified exposure limitations;
 4. That these provisions are applicable to duct connections to equipment and to apparatus but are not for equipment and apparatus;
 5. That where distinctions between seams and joints are made herein, a seam is defined as joining of two longitudinally (in the direction of air-flow) oriented edges of duct surface material occurring between two joints. Helical (spiral) lock seams are exempt from sealant requirements. All other duct surface connections made on the perimeter are deemed to be joints. Joints are inclusive of but not limited to girth joints; branch and sub-branch intersections; so-called duct collar tap-ins;

fitting subsections; louver and air terminal connections to ducts; access door and access panel frames and jambs; duct, plenum and casing abutments to building structures; that sealing requirements herein do not contain provisions to:

- a. Resist chemical attack.
 - b. Be dielectrically isolated.
 - c. Be waterproof, weatherproof or ultraviolet ray resistant.
 - d. Withstand temperatures higher than 120°F or lower than 40°F.
 - e. Contain atomic radiation or serve in other safety-related construction.
 - f. Be electrically grounded.
 - g. Maintain leakage integrity at pressures in excess of the duct classification herein.
 - h. Be underground below the water table.
 - i. Be submerged in liquid.
 - j. Withstand continuous vibration visible to the naked eye.
 - k. Be totally leak-free within an encapsulating vapor barrier.
 - l. Create closure in portions of the building structure used as ducts, e.g., ceiling plenums, shafts, pressurized compartments.
6. The requirements to seal apply to both positive pressure and negative pressure of operation.
 7. Externally insulated ducts located outside of buildings shall be sealed prior to being insulated as though they were inside. If metal surfaces of ducts located on the exterior of buildings are exposed to weather, they shall receive exterior duct sealant. An exterior duct sealant is defined as a sealant that is marketed specifically as forming a positive air and water tight seal, bonding well to the metal involved, remaining flexible with metal movement and having a service temperature range of -30°F to 175°F. If exposed to direct sunlight it shall also be ultraviolet ray and ozone resistant or shall, after curing, be painted with a compatible coating that provides such resistance. The term sealant herein is not limited to materials of adhesive or mastic nature but is inclusive of tapes and combinations of open weave fabric strips and mastics.

C. Materials and applications for sealing ducts:

1. General:
 - a. Complete product data on all materials used for sealing ducts must be submitted for approval prior to any duct fabrication.
 - b. All sealants must be specifically recommended by their manufacturer for the purpose of sealing ducts.
2. Liquid Sealant:
 - a. Use only for slip type joints where sealant is to fill small space between overlapping pieces of metal. Do not use where metal clearances exceed 1/32-inch.
 - b. Sealant must be specifically manufactured for the purpose of sealing ducts.
3. Mastics:
 - a. Use in lieu of liquid sealant at Contractor's option.
 - b. Use as a fillet, in grooves and between flanges.
 - c. Do not use oil base caulking or glazing compounds.

LINE 1
LINE 2

NO.

4. Gaskets:
 - a. Use soft elastomer butyl or neoprene rubber or extruded forms of sealants in flanged joints in addition to mastic.
5. Tape:
 - a. Tape is not allowed on sheet metal ducts.
6. Combination of mastic and embedded fabric:
 - a. Use mastic/mesh/mastic as a sealant where pressure/velocity classification equals and exceeds P/VC-3 and where any spaces between metal surfaces at transverse joints or longitudinal seams or duct wall penetrations exceeds 1/16-inch.
 - b. Apply glove coat of mastic, then embed a continuous or overlapping strip of not less than 4-inch wide 10 x 10 fiberglass cloth into the mastic, then apply a final glove coat of mastic over the glass cloth.
7. Surface preparation:
 - a. Surfaces to receive sealant should be adequately clean (free from oil, dust, dirt, rust, moisture, ice crystals and other substances that inhibit or prevent bonding). Use solvent and/or apply a face primer if necessary to obtain adequately clean surface for adhesion.

3.19 LEAKAGE TESTING

A. General:

1. Test the following duct systems:
 - a. All ducts which are (1) under positive or negative pressure and (2) which are directly connected to air moving device (air handling unit, exhaust fan, supply fan or similar air moving equipment) and (3) which convey 1000-cfm or greater through their largest portion.
 - b. All ducts which are (1) under positive or negative pressure and (2) which are part of a supply, return, outside and/or exhaust air system and (3) which are equal to or greater than 25 feet in length and (4) which may or may not be directly connected to an air moving device.
2. Portions of duct to be tested shall consist of all portions from the largest cross sectional area to the air distribution device connection or to the smallest inlet or outlet point, whichever is applicable.
3. Duct systems shall be constructed so that leakage does not exceed 5.00% of the air quantity handled by the respective fan.

B. Allowable Leakage:

1. Leakage shall be measured during leakage test at a test pressure which is equal to the pressure/velocity classification of the duct system (e.g., a P/VC-2 duct shall be tested at 2.0 in. w.g.s.p., a P/VC-1/2 duct at 0.5 in. w.g.s.p., etc.).

C. Test Procedure:

1. Test at time of duct installation and prior to installation of any field applied insulation and prior to any concealment in chases or similar enclosures.
2. Duct openings (both entry openings and outlet openings) shall be capped or sealed by taping or banding a flexible plastic sheet over each opening prior to pressurizing duct. The plastic sheet shall be of adequate strength and thickness to withstand the test pressures. Use other method of sealing duct openings providing objective of test is obtained and if method of sealing is approved by Architect/Engineer.
3. Use a fan having a minimum capacity of 300-cfm or 5% of the particular duct system design capacity, whichever is greater and which is capable of producing a duct test pressure of 150% of the duct test pressure.
4. Test fan shall be connected to a flow measuring assembly consisting of straightening vanes and an orifice plate mounted in a straight tube with appropriately located pressure taps. Orifice assembly shall be accurately calibrated with its own calibration curve. Pressures shall be measured with U-tube manometers and corresponding flow rates obtained from the orifice performance curve.
5. Connect test fan and orifice flow measuring assembly to the duct to be tested with a section of flexible duct.
6. Test for audible leaks as follows:
 - a. Close off and seal all openings in the duct section to be tested. Connect the test apparatus to the duct by means of a section of flexible duct.
 - b. Start the blower with its control damper closed (some small blowers popularly used for testing ducts may damage the duct because they can develop pressures up to 25 inches (W.G.).
 - c. Gradually open the inlet damper until the duct pressure reaches 50% in excess of designed duct operating pressure.
 - d. Survey all joints for audible leaks. Mark each leak and repair after shutting down blower. Do not apply a retest until sealing has been repaired if and where necessary.
7. After all audible leaks have been sealed, the leakage should be measured with the orifice section of the test apparatus as follows:
 - a. Start blower and open damper until pressure in duct reaches 25% in excess of designed duct operating pressure.
 - b. Total allowable leakage shall not exceed five (5) percent of the total system design air flow rate. When partial sections (such as supply section, return section, etc.) of the duct system are tested, the summation of the leakage for all sections shall not exceed the total allowable leakage.
8. Correct any duct leaks which are detected either audibly or by touch regardless of whether leakage through duct system is less than allowable test leakage.

3.20 PAINTED DUCT

- A. Paint all uninsulated exposed exhaust and outdoor air duct and exposed double wall ductwork with two coats of rust inhibiting paint. Color to be battleship grey or as specified by architect.

3.21 DEFINITIONS OF DUCT TYPES

LINE 1
LINE 2

NO.

A. Refer to the "DUCT PRESSURE/VELOCITY CLASS SCHEDULE" on the Drawings for:

1. The type of ductwork and where it is to be installed.
2. The pressure/velocity class at each location.

3.22 DEFINITIONS OF DUCT TYPES

A. Construct supply duct from air handling unit to air terminal unit to a 6-inch pressure/velocity class.

B. Construct supply duct from air terminal unit to supply air device to a 2-inch pressure/velocity class.

C. Construct return duct from return air device to air handling unit to a 4-inch pressure/velocity class.

D. Construct exhaust and outside air duct to a 2-inch pressure/velocity class.

END OF SECTION 23 31 00

SECTION 23 33 00 - DUCT SYSTEM ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. Provide all necessary duct system accessories to assure proper balance, quiet and draftless distribution and conveyance, and minimization of turbulence, noise and pressure drop for all supply return, exhaust and ventilation air quantities indicated.
- B. Items Included: This section generally includes, but is not limited to, the following items as may be applicable to this project:
 - 1. Flexible duct connections.
 - 2. Splitters.
 - 3. Turning vanes.
 - 4. Extractors.
 - 5. Manual volume dampers.
 - 6. Access doors.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 23 and to all other applicable portions of the Drawings and Specifications.
- B. This section directly relates in particular to sections (which may or may not be included in this division) which describe the following:
 - 1. Ductwork.
 - 2. Air distribution devices.
 - 3. All types of air handling equipment.

1.4 COORDINATION

- A. Coordinate all items affecting the duct systems including but not limited to the following items: air handling units, exhaust fans, supply fans, sound attenuators, duct mounted coils, access panels air distribution devices, fire dampers, outside air louvers, hoods, filters, roof curbs, structural framing, roof construction, roofing, and the work of all trades to insure an orderly and timely progression of the work.

1.5 SHOP DRAWINGS

- A. Include complete data on: access doors; flexible connectors; manual volume dampers including operating hardware; extractors; turning vanes; automatic shutters and all other items.

B. See section entitled, "General Mechanical Provisions".

1.6 OTHER REQUIREMENTS

A. Provide all components in accordance with manufacturer's recommendations.

B. All ductwork dimensions indicated which may affect items of this section are nominal free clearance internal dimensions which do not include insulation thickness.

1.7 DEFINITIONS

A. "SMACNA" means "Sheet Metal and Air Conditioning Contractors National Association, Inc.".

PART 2 - PRODUCTS

2.1 GENERAL

A. Be recommended by the manufacturer for the application.

B. Products listed in this Section or on the plans are based on a specific manufacturer to establish the desired style, quality and type. Equivalent products, complying with the requirements of this Section and the installation requirements of the plans, by the following manufacturers are acceptable:

1. Ventfabrics
2. Barber-Colman
3. Tuttle & Bailey
4. Dura-Dyne
5. Airsan
6. Titus
7. Anemostat
8. Young
9. Metalaire
10. United McGill
11. Metropolitan Air Technology

C. Products which are specified may not necessarily all be required on the projects; provide those products which are applicable.

2.2 FLEXIBLE DUCT CONNECTIONS

A. Provided where air handlers, fans and blowers connect to their ductwork.

B. At least 4 inches long.

C. Connected on each side to metal (either metal ductwork, air handling apparatus, or heavy gauge steel sleeves).

D. For use in high and/or low pressure duct systems.

E. Ventfabrics, Inc., "Ventglas Metaledge", or equivalent.

2.3 SPLITTERS

- A. Provide for adjustment of air volume to their respective branches, where indicated. Constructed of at least the same gauge galvanized steel as the duct wherein they are used, and in no instance be less than twenty-two (22) US gauge. Use in low pressure duct systems only. Be adequately sized to close off air to applicable branches. Rigidly attached to pivot rod and operating linkage. Install on raised insulated base when used in internally insulated ductwork. Splitter blades; formed in two thicknesses of metal so that entering edge presents rounded nose to air flow; length no less than one and one half times the width of the smaller branch served or twelve inches, whichever is larger. Hardware used for the construction, assembly, and operation of splitter dampers shall be as follows:

1. Operators for exposed splitters and those located above "lay-in" or accessible ceiling shall be Ventlok #690 splitter damper assembly.
2. Operators for concealed splitters shall be Ventlok #691 with #680 miter and #677 concealed regulator.

2.4 LOW PRESSURE METAL TURNING VANES

- A. Provide in all elbows, bends and tees of all low velocity supply air ducts whether or not shown in detail; provide in all elbows, bends and tees of all other low velocity ducts where portions of such ducts convey air at greater than 700 fpm average velocity. Adequate rigidity and strength to be completely flutterproof; properly designed; permanently fixed type. Aluminum, or steel with acid/solvent chemical corrosion resistant coating, or galvanized steel. Air foil type in all mitered elbows, mitered bends and tees. Air foil type must be manufactured by Titus, Tuttle & Bailey, Anemostat, Waterloo, Metalaire, Barber-Colman or other approved manufacturer. Be Barber-Colman "Airturms", Tuttle and Bailey "Ducturms", or Dura-Dyne "VR" with 24 gauge rails and hollow vanes, or equivalent.

2.5 HIGH PRESSURE TURNING VANES

- A. Same as low pressure metal turning vanes but rated and constructed for velocities up to 2500 fpm and pressure class of ductwork.

2.6 EXTRACTORS

- A. Provide at rectangular branch duct take-offs.
- B. Use in low pressure duct systems only.
- C. Properly designed to deflect, proportion and direct the indicated air quantities to the branch duct and/or to the registers, grilles or other outlets without causing objectionable noise or pressure drop.
- D. Multivaned and adjustable.
- E. Aluminum, or steel with acid/solvent chemical corrosion resistant coating, or galvanized steel.
- F. Provided with devices for adjusting and securing the position of these deflectors; these devices shall allow adjustment of the deflectors from outside the completed ductwork without necessity for puncturing or otherwise penetrating ductwork and/or its vapor barrier.
- G. Made by Titus, Tuttle and Bailey, Metalaire, Anemostat, Waterloo, Barber-Colman, or equivalent.
- H. Be similar to Titus Model AG-45 or AG-225 Volume Extractor, Tuttle & Bailey Type VCL or VLK Vectrol, Waterloo Type DTM or DT2M Extractor, Anemostat "DTB" or "DTA" or Young Regulator "890" or 890A", or equivalent.

2.7 MANUAL VOLUME DAMPERS

- A. These dampers are to be other than those specified as being integral with each register, diffuser and other air outlet or inlet.
- B. Provided where indicated in the complete air distribution system(s) (including ductwork, return air plenums, etc.) to allow complete balancing of the air supply, return, ventilation and exhaust system(s).
- C. Opposed blade type.
- D. 8" maximum blade width.
- E. Made of galvanized steel, steel with acid/solvent chemical resistant coating, or steel with a sprayed or dipped aluminum rust resistant finish; flutterproof.
- F. Provided so that all damper adjustment can be made from outside the completed ductwork without necessity for puncturing or otherwise penetrating the ductwork and/or its vapor barrier.
- G. Fully adjustable and with locking device.
- H. Manufactured by Titus, Tuttle & Bailey, Anemostat, Waterloo, Greenheck, Metalaire, Ruskin or equivalent. Basis of Design: Greenheck MBD-15.
- I. Provided at a point in the ductwork which is a sufficient distance upstream from an outlet (or downstream from an inlet) to attenuate objectionable noise due to damper throttling and to preclude adverse effects on the distribution device.
- J. Based upon location of the duct in which the damper is to be installed, provide the following types:
 - 1. Dampers in ducts which are exposed or located above "lay-in" or "accessible ceilings": Young Regulator Company Bowden Cable Controls, Metropolitan Air Technology RT-100 or RT-200 series, or equivalent.
 - 2. Dampers in ducts concealed above plaster ceilings or behind dry wall construction: Young Regulator Company Bowden Cable Controls, Metropolitan Air Technology RT-100 or RT-200 series, or equivalent.
- K. Use in low pressure duct system only and constructed to duct system pressure class in which damper is to be installed

2.8 LOW PRESSURE DUCT ACCESS DOORS

- A. Provided for: each manual and motorized damper; fire damper; smoke damper; electric duct heater; and where access is otherwise necessary.
- B. Factory prefabricated double wall insulated type of 24 US gauge galvanized steel (of same or thicker gauge than ductwork panel in which installed, whichever is greater).
- C. Minimum size shall be as large as is compatible with duct size but in no case less than the following (provide larger sizes if necessary to permit proper access operation):

Max. Duct Dimensions

Access Door Size

11" and less	10" x 12"
12" through 16"	12" x 16"
17" and over	16" x 24"

- D. Doors shall be provided with and operated adjustable tension catches and shall be completely gasketed around their perimeters. Doors shall be Ventlok "Access Doors". Install in accordance with manufacturers recommendations using Ventlok #360 sealant or equivalent.

2.9 TEST OPENINGS

- A. Furnish and install gasketed capped test openings for test equipment (pitot tubes, etc.) on the entering and leaving sides of air handling unit and other air handling equipment and heating coils. Test openings shall be Ventlok #699-2 or equivalent.

2.10 PREFABRICATED DUCT CONNECTIONS

- A. At Contractor's option, prefabricated duct connections as manufactured by Ductmate (or approved equal system) may be used in locations and applications for which the duct connection system is recommended. Use of these connections must meet or exceed specified duct construction quality as related to structural rigidity, pressure, accessibility and other such requirements.

PART 3 - EXECUTION

3.1 GENERAL

- A. Construct and install all accessories in accordance with the latest indicated editions of applicable SMACNA construction standards.
- B. Provide all mitered elbows with turning vanes.
- C. Install all duct system accessories in accordance with manufacturer's recommendations.
- D. All accessories installed in poly-vinyl-steel ductwork shall have acid/solvent chemical corrosion resistant coating.
- E. All manual damper arms shall be tagged with fluorescent colored strip.

END OF SECTION 23 33 00

SECTION 23 33 14 - DAMPERS: FIRE AND FIRE/SMOKE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. All work of this section shall be governed by all provisions of the general, supplementary and special conditions of these specifications and the drawings.
- B. Take adequate precautions to insure that installed dampers/operators are protected from damage during construction.

1.3 RELATION TO OTHER WORK

- A. Refer to the section "General Mechanical Provisions" for related requirements. Refer to other sections of Division 23 and to all other applicable portions of the drawings and specifications.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Fire dampers shall comply with Underwriters Laboratories (UL) Standard 555, bear the UL test label and be dynamic type.
- B. Fire/Smoke dampers shall comply with Underwriters Laboratories (UL) Standard 555(S) and bear the UL test label.
- C. The sheet metal installer, in conjunction with the metal stud installer and drywall installer, shall fabricate a mock-up of each type of fire damper installation in a one-hour fire wall. The mock-ups shall contain all required framing, retaining angles, sleeves, caulking, drywall and other appurtenances as shown on the details and/or the manufacturer's installation instructions. After fabrication the mock-ups shall be approved by the Architect/Engineer. The mock-ups shall remain on the project premises to be used for reference and training purposes.
- D. Provide dampers which are to be installed in a horizontal plane with spring closing mechanisms.

2.2 CURTAIN-TYPE FIRE DAMPERS

- A. Fire dampers shall be constructed with casings of galvanized steel interlocking type damper blade assembly, and fusible link rated at 160-165°F unless noted otherwise on the drawings. Provide integral sleeve frame minimum 20 gauge x 12 inches roll formed, galvanized steel. Where frame and sleeve are not roll formed together as one-piece integral sleeve frame, provide factory furnished duct installation sleeve. Sleeve shall be minimum 16 gauge for dampers up to 36" wide x 24" high and 14 gauge for sizes exceeding 36" x 24". Dampers shall be Style "B", 100% full duct opening, and bear 1-1/2 hour UL label.
- B. Picture Frame Mounting Angles:

1. One-piece, roll formed retaining angles, 1-1/2 x 1-1/2 inches.
 2. Factory matched and shipped on individual damper.
 3. Factory prepunched screw holes.
- C. Acceptable manufacturers are: Prefco, Pottorff, American Warming & Ventilating, Inc., Nailor Hart, Louvers and Dampers and Air Balance, Inc., Safe Air, Greenheck, United Enertech, or equivalent. Basis of Design: Ruskin Mfg. Co.

2.3 MULTI-BLADE TYPE FIRE DAMPERS

- A. Provide multi-blade type spring-driven fire dampers in types and sizes indicated, with casing constructed of 10 gauge galvanized steel, fusible link 160-165°F (71-74°C), unless otherwise indicated, and matching factory furnished installation sleeve.
- B. Acceptable manufacturers are: Nailor Hart, Pottorff, Louvers and Dampers, American Warming & Ventilating, Prefco and Air Balancing, Inc., Safe Air, Greenheck, United Enertech, or equivalent. Basis of Design: Ruskin Mfg. Co.

2.4 COMBINATION FIRE/SMOKE DAMPERS

- A. Provide multi-blade type motor-driven fire/smoke dampers in types and sizes indicated, with casing constructed of 16 ga. galvanized steel with electronic fusible link 160°-165°F (71-74°C), unless otherwise indicated, with electric actuator, motor mounting bracket, and 32" long wire leads for connecting to smoke detector and matching factory furnished installation sleeve.
- B. Actuator shall be mounted out of air stream unless otherwise indicated or as required for accessibility of damper actuator with prior approval from architect/engineer.
- C. Actuator shall be equal to Belimo, Honeywell, or approved equal.
- D. Actuator shall be 120V electric powered with auxiliary switch built in for position indication.
- E. Temperature Release Device: Heat-Actuated, Quick Detect.
1. Close (in a controlled manner) and lock damper during test, smoke detection, power failure, or fire conditions through actuator closure spring. At no time shall actuator disengage from damper blades.
 2. Allow damper to be automatically and remotely reset after test or power failure conditions. After exposure to high temperature or fire, inspect damper before reset to ensure proper operation.
 3. Controlled closing and locking of damper in 7 to 15 seconds to allow duct pressure to equalize. Instantaneous closure is not acceptable.
- F. Acceptable Manufacturers are: Nailor Hart, Pottorff, Louvers and Dampers, American Warming & Ventilating, Prefco, United Enertech, Greenheck and Air Balancing, Inc. Basis of Design: Ruskin Mfg. Co.

PART 3 - EXECUTION

3.1 GENERAL

- A. Provide access doors to facilitate relinking of fire and fire/smoke dampers.
- B. See installation details on plans.
- C. Adhere strictly to damper manufacturer's instructions.
- D. Install multi-blade type fire dampers in ducts at grilles and registers if and where indicated on drawings.
- E. Install curtain type fire dampers where indicated on drawings at locations other than grilles and registers.
- F. Install combination fire/smoke dampers where indicated on Drawings.

END OF SECTION 23 33 14

SECTION 23 36 17 - TERMINAL UNITS: VAV, SINGLE INLET

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. Provide single inlet, variable air volume (VAV or CV) terminal units of types, sizes and capacities indicated.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 23 and to all other applicable portions of the Drawings and Specifications.

1.4 SHOP DRAWINGS

- A. Refer to Section entitled "General Mechanical Provisions". Include: complete performance data at the scheduled operating conditions; dimensions; performance data; pressure losses; descriptions; discharge and radiated sound power levels at the stated conditions.
- B. Submit calculated room NC levels based on typical sound attenuation values for small, medium, and large boxes as defined in AHRI Standard 885-2008, Table D18, with the exception of Duct Lining attenuation. Submittals not containing predicted NC levels will be rejected without review.

1.5 MANUFACTURER

- A. Products listed in this Section or on the plans are based on a specific manufacturer to establish the desired style, quality and type. Equivalent products, complying with the requirements of this Section and the installation requirements of the plans, by the following manufacturers are acceptable:
 - 1. Titus
 - 2. Price
 - 3. Enviro-tec / JCI
 - 4. Trane
 - 5. Metalaire / Greenheck
 - 6. Nailor

1.6 TERMINOLOGY

- A. The word "box" or "terminal unit" used throughout this section without any modifying adjective shall mean the entire terminal unit assembly including all other accessories integral therewith, unless otherwise indicated. Terminal units may be referred to as "TU".

1.7 NOISE CRITERIA

- A. Unless otherwise indicated on drawings, the following noise criteria comprise the basis upon which the selected terminal units must be rated in order to comply with the design limits for allowable NC levels:
 - 1. All sound power level decibels are referenced to 10 to the minus 12 watts.

2. The maximum allowable NC level in any occupied space (unless otherwise indicated) shall not exceed NC35 as a result of radiated or discharge noise from any terminal unit.
3. NC levels which are generated by the terminal units on which noise criteria will be judged are those NC levels generated when the terminal unit is operating with an inlet static pressure of 1.0-inch w.g.
4. NC levels are to be based on typical sound attenuation values for small, medium, and large boxes as defined in AHRI Standard 885-2008, Table D18, with the exception of Duct Lining attenuation.

1.8 SELECTION

- A. Terminal units shall be selected for maximum air discharge within the mid-range of the TU rating so that field adjustment of maximum indicated discharge air quantity may be made plus and minus 15%.

1.9 LEAKAGE

- A. Terminal units intended for full shut-off operation shall not have air leakage of more than 2% of nominal box capacity when inlet pressure is 6.0 inches w.g.

1.10 PRESSURE DROP

- A. Maximum allowable static pressure drop across the control box portion of any terminal unit (i.e., excluding any applicable companion sound attenuator or heating coil) shall not exceed 0.20 inches w.g. or the value(s) scheduled on drawings. Maximum allowable minimum operating pressure of the entire unit shall not exceed 0.50 inches w.g.

PART 2 - PRODUCTS

2.1 TERMINAL UNITS

- A. Control Unit: Galvanized steel or aluminum casing; insulated internally to prevent condensation (comply with NFPA 90A); acoustically treated to reduce noise level; air quantity indicator; access panel(s) for complete access to all parts of the assembly which may require service, maintenance and repair.
- B. Sound Attenuators: Factory made companion items to the control box. Provide when either of the following conditions exist:
 1. If companion sound attenuators are indicated on the drawing schedule.
 2. If companion sound attenuator must be provided in order to comply with the noise criteria limits indicated.

2.2 COMPANION ELECTRIC HEATING COIL

- A. General: Each terminal unit shall be provided with an integral, factory mounted electric heating coil. Heating coils shall have all operating characteristics completely coordinated to function satisfactory as an integral part of the terminal unit. Capacities for each integral heater shall be as scheduled on the drawings.
- B. Other Requirements:
 1. Meet all applicable requirements of the current NEC.
 2. UL listed including all built-in components.

3. Coordinated with the specified requirements of the mechanical system control system.
- C. Materials:
1. Open coil type.
 2. Full fine break mercury contactors which will break all ungrounded conductors (note horizontal, vertical or oblique position of each heater assembly as shown on drawings).
 3. Transformer with primary fusing if control voltage is different from supply voltage.
 4. Overcurrent protection in accord with NEC requirements.
 5. Control terminals and power terminals.
 6. Built-in or remote pressure type air flow switch. Install in series with automatic reset thermal cutout.
- D. Wiring Diagrams: Provide complete wiring diagram furnished by the heating coil system manufacturer to the mechanical systems control manufacturer and the Electrical Contractor. This wiring diagram shall completely indicate in full detail all electrical and control wiring requirements, terminal, etc. necessary to allow the control manufacturer and Electrical Contractor to completely coordinate their respective wiring portions of the heating coil system installation.

2.3 CONTROL REQUIREMENTS

- A. Pressure Independent Operation: Terminal units must operate independent of inlet pressure fluctuations in the main or branch duct system. Units must have controls which are factory installed, factory calibrated and factory tested to be pressure-independent. This pressure-independent feature must be a standard catalogued feature or available and provided as a standard catalogued option.
1. Units shall maintain constant discharge flow for any given setpoint with any variation in inlet static pressure between 0.2 inches w.g. and 6.0- inches w.g.
 2. All terminal units must be factory set for design air flow and for minimum air flow.
- B. Adjustment: Unit must have capability for easy field adjustment of maximum and minimum air quantities by resetting of control mechanism(s) on terminal unit.
- C. Operation:
1. Discharge volume setting shall be controlled throughout indicated variable volume operating range as dictated by the controller which signals air flow requirements.
 2. Controls integral with the terminal unit shall be provided by the terminal unit manufacturer. This includes damper motors and similar items.
 3. Controls must be completely compatible in all respects with the related components of the building temperature control system.
- D. Refer to section describing control operation and to control diagrams for coordination.
- E. Sensor: In addition to other requirements, the terminal unit shall have an inlet flow/pressure sensor which is designed to operate in conjunction with variable air volume exhaust hood control systems where applicable.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate location with all ducts, beams, joists, conduit, lights, piping, air distribution devices and other items in immediate vicinity of indicated locations. Make minor adjustments in exact locations shown to best fit available space.
- B. Make all duct connections to and from boxes in as streamlined a manner as practical so that air pressure drop is minimized. Make such connections air tight at operating pressures encountered. Coordinate exact box location and inlet duct connection so that any straight diameters of inlet duct are provided as may be required by the terminal unit manufacturer for proper operation.
- C. Locate boxes so that access for repair, maintenance and adjustment is easily facilitated without removal of other permanently located items which are in the immediate vicinity of boxes (this excludes removable ceiling panels, removable air distribution devices attached to flexible ductwork and other similar items).
- D. No terminal unit outlet (including companion sound attenuator, if needed) shall be nearer than 60-inches from the first flexible duct connection take-off to the first downstream air distribution device.
- E. Coordinate controls to take into account reverse or direct acting thermostats, whether TUs are normally open or normally closed, and similar interfacing.

END OF SECTION 23 36 16

SECTION 23 37 13 - AIR DISTRIBUTION DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. Provide all air distribution devices as indicated on the drawings and as specified herein for a complete and operable system.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 23 and to all other applicable portions of the Drawings and Specifications.
- B. Coordinate with work of the ceiling, drywall and plastering trades as required to insure an orderly progression of work and a first class finished system with respect to placement, alignment, finish, general fit and absence of conflict with lighting systems and fire protection systems.

Insulate air distribution devices to prevent condensation formation.

1.4 DESIGN CONDITIONS

- A. 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 0.002 microbars unless otherwise indicated. Coordinate air distribution devices, sound attenuation measures and equipment actually provided to ensure that this design constraint is not exceeded by the system installed.

Exceptions: Any particular rooms or areas which are normally occupied by other than maintenance staff or service staff and which may be noted on the drawings as requiring lower NC criteria.

- B. Pressure Drop: Pressure drop across any air distribution device shall not exceed 0.1 in wg static pressure unless otherwise indicated.

1.5 SHOP DRAWINGS

- A. Refer to the requirements of Section entitled "General Mechanical Provisions".
- B. At minimum, include in submittal:
 - 1. Identification as indicated on plans and schedules.
 - 2. Manufacturer's name and clearly marked model number.
 - 3. Performance data including throw, pressure drop, and NC levels.
 - 4. Materials of construction.
 - 5. Dimensions and finishes.
 - 6. All other pertinent data.

1.6 MANUFACTURER

- A. Products listed in this Section or on the plans are based on a specific manufacturer to establish the desired style, quality and type. Equivalent products, complying with the requirements of this Section and the installation requirements of the plans, by the following manufacturers are acceptable:
 - 1. Titus
 - 2. Metalaire / Greenheck
 - 3. Price
- B. Manufacturers must be members of the Air Distribution Council unless otherwise indicated.

1.7 OTHER REQUIREMENTS

- A. All aluminum is to be extruded unless otherwise indicated.
- B. Appearance: Each air distribution device which has a portion thereof (frame, core, etc.) exposed to view in the finished area shall have a factory applied finish which matches and is compatible with the color of the surrounding surface on which the device is installed. Colors must be approved by Architect prior to device fabrication.
- C. All louvers, dampers and/or shutters shall be rated by their manufacturer in accord with AMCA Standard 500-74.
- D. Integral Components: All dampers, blank-off baffles and other companion devices which form an integral part of air distribution device shall be factory made items produced by the manufacturer of air distribution device.
- E. Louvers: Louvers may be specified in another division but for reference may also be indicated on mechanical drawings.
- F. Door Grilles: Door grilles may be specified in another division but for reference may also be indicated on mechanical drawings.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide the following air distribution devices as applicable to this project. Refer to air distribution device schedule as shown on drawings.

2.2 OTHER REQUIREMENTS

- A. All devices must each comply with the applicable portions of the Air Diffusion Council (ADC) Equipment Test Code 1062R4 "Certification, Rating and Test Manual", the Air Movement and Control Association, Inc. (AMCA) Standard 500 "Test Method for Louvers, Dampers and Shutters" and the "National Fire Protection Association" (NFPA) Standard 90A "Installation of Air Conditioning and Ventilating Systems".
- B. Provide ceiling and/or linear diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of diffuser.
- C. Diffusers, grilles and registers installed in fire rated ceiling, or floor/ceiling assemblies shall be constructed of steel.

- D. Mounting Screws: Where grilles, diffusers or registers are specified which require mounting screws visible from the face of the device these screws shall be furnished with the air distribution equipment and be finished at the factory to match the finish on the grille, diffuser or register in which they are to be used.
- E. Opposed blade dampers, if scheduled, shall be of same material as air distribution device.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install neatly where indicated in accord with manufacturer's recommendations and in accord with SMACNA recommendations and as otherwise indicated.
- B. Properly test, balance and adjust to produce quiet, draftless operation to best degree possible.

3.2 INSTALLATION

- A. Rectangular Diffusers: Where diffusers are the lay-in type, they shall be supported by the inverted T-bar suspension system but all ducts connected thereto shall be supported independently of the ceiling as specified under Section entitled "Ductwork". Surface mounted diffusers shall be supported by the duct runouts or drops where sheet metal ducts are indicated and by separate hangers where flex runouts are indicated. All rectangular ceiling diffusers shall be installed with their lines parallel and perpendicular to the building line and properly aligned with the ceiling.
- B. Sidewall Grilles and Registers: Mount securely to the duct system flanges using finish screws and in accordance with accepted good practice.
- C. Ceiling mounted Exhaust and Return Registers/Grilles: Mount as specified hereinbefore for surface mounted ceiling diffusers except use finished screws provided and secure to duct and finished ceiling (or finished ceiling for nonducted returns) in accordance with the manufacturer's instructions. Where required to provide adequate support for nonducted registers or grilles, provide appropriate mounting frame for incorporation into the ceiling system.
- D. Install all outlets and inlets as recommended by the manufacturer; in accordance with recognized industry practices; to ensure that products serve intended functions.
- E. Locate ceiling air outlets and inlets as indicated on the drawings. Unless otherwise indicated, locate units in center of acoustical ceiling modules. Install square and parallel with partitions, ceiling grid members, etc.
- F. Spare Parts: Furnish to Owner, with receipt, 3 operating keys for each type of outlet and inlet that require them.
- G. Do not install blank-offs under continuous linear diffuser distribution plenums. Distribution plenums shall cover only active portion of the diffuser.

3.3 PROTECTION OF WORK UNTIL FINAL ACCEPTANCE

- A. Coordinate the installation of the air distribution equipment with related work and finishing of adjacent surfaces to prevent damage to the devices or adjacent finishes. Protect the finish of all air distribution equipment until final acceptance. Replace or repair to the Architect's satisfaction any damaged equipment.

END OF SECTION 23 37 13

SECTION 23 73 13 - INDOOR, SEMI-CUSTOM AIR-HANDLING UNITS

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 insulated, double-wall-casing, indoor, semi-custom air-handling units that are factory assembled using multiple section components, including the following:
 - 1. Casings.
 - 2. Fans, drives, and motors.
 - 3. Coils.
 - 4. Air filtration.
 - 5. Dampers.
 - 6. Air-to-air energy recovery.
 - 7. UV-C lamp systems.

1.3 ACTION SUBMITTALS

- A. Product Data: For each air-handling unit.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 3. Include unit dimensions and weight.
 - 4. Include cabinet material, metal thickness, finishes, insulation, and accessories.
 - 5. Fans:
 - a. Include certified fan-performance curves with system operating conditions indicated.
 - b. Include certified fan-sound power ratings.
 - c. Include fan construction and accessories.
 - d. Include N-1 fan performance for multiple fan systems.
 - e. Include motor ratings, electrical characteristics, and motor accessories.
 - 6. Include certified coil-performance ratings with system operating conditions indicated.
 - 7. Include filters with performance characteristics.
 - 8. Include dampers, including housings, linkages, and operators.
- B. Sustainable Design Submittals:
 - 1. Product data showing compliance with ASHRAE 62.1.
 - 2. Product Data: For air filtration performance.
 - 3. Product Data: For adhesives, mastics, and sealants, indicating VOC content.

4. Laboratory Test Reports: For adhesives, mastics, and sealants, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: For each type and configuration of indoor, semi-custom air handling unit.
1. Include plans, elevations, sections, and mounting and attachment details.
 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. Detail fabrication and assembly of indoor, semi-custom air-handling units, as well as procedures and diagrams.
 4. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and other details, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. Source quality-control reports.
- C. Startup service reports.
- D. Field quality-control reports.
- E. Sample Warranty: For manufacturer's warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

1.6 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.
 1. Filters: One set(s) for each air-handling unit.

1.7 WARRANTY

- A. Warranty: Manufacturer agrees to repair or replace components (both parts and labor) of indoor, semi-custom air-handling units that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: 1 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. 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.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- E. Structural Performance: Casing panels shall be self-supporting and capable of withstanding positive/negative 8-inch wg of internal static pressure, without exceeding a midpoint deflection of 0.0042 inch/inch of panel span.
- F. Casing Leakage Performance: ASHRAE 111, Class 6 leakage or better at plus or minus 8 inch wg.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carrier Corporation.
 - 2. Daikin Applied.
 - 3. Tentrol Inc.
 - 4. Trane.
 - 5. YORK; a Johnson Controls company.

2.3 UNIT CASINGS

- A. Frame: Modular and providing overall structural integrity without reliance on casing panels for structural support.
- B. Base Rail:
 - 1. Material: Galvanized steel.
 - 2. Height: 6 inches minimum.
- C. Casing Joints: Hermetically sealed at each corner and around entire perimeter.
- D. Double-Wall Construction:
 - 1. Outside Casing Wall:
 - a. Material, Galvanized Steel: Minimum 24 gauge thick.
 - b. Factory Finish: Provide manufacturer's standard finish.
 - 2. Inside Casing Wall:

- a. Material, Galvanized Steel: Solid, minimum 24 gauge thick.
- b. Coating: On units with outside air percentage greater than 30%, casing shall be provided with a factory applied heresite corrosion protection coating or equal with at least 10000 hr salt spray protection per ASTM B 117. In lieu of coating, aluminum or series 300 stainless steel may be used.

E. Floor Plate:

- 1. Material, Galvanized Steel: Minimum 16 gauge thick.
 - a. Treadplate: On units with accessible sections with a height of 60 inches or greater.
 - b. Coating: On units with outside air percentage greater than 30%, floor plate shall be provided with a factory applied heresite corrosion protection coating or equal with at least 10000 hr salt spray protection per ASTM B 117. In lieu of coating, aluminum or series 300 stainless steel may be used.
- 2. On units with bottom openings or duct connections, provide walkable safety grating across entirety of opening.

F. Casing Insulation:

- 1. Materials: Injected polyurethane foam insulation.
- 2. Casing Panel R-Value: Minimum R-13.
- 3. Insulation Thickness: 2 inches.
- 4. Thermal Break: Provide continuity of insulation with thermal break in casing walls, floors, and roofs of air-handling unit.

G. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.

H. Static-Pressure Classifications:

- 1. For Unit Sections Upstream of Fans: Minus 4-inch wg.
- 2. For Unit Sections Downstream and Including Fans: 6-inch wg.

I. Panels, Doors, and Windows:

- 1. Panels:
 - a. Fabrication: Formed and reinforced, double-wall and insulated panels of same materials and thicknesses as casing.
 - b. Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against airflow
 - c. Gasket: Neoprene, applied around entire perimeters of panel frames.
 - d. Size: Large enough to allow unobstructed access for inspection and maintenance of air-handling unit's internal components. At least 18 inches wide by full height of unit casing up to a maximum height of 72 inches.
- 2. Doors:
 - a. Fabrication: Formed and reinforced, double-wall and insulated panels of same materials and thicknesses as casing.
 - b. Hinges: A minimum of two ball-bearing hinges or stainless-steel piano hinge and two wedge-lever latches, operable from inside and outside. Arrange doors to be opened against airflow. If doors cannot be opened against airflow, provide safety latch retainers on doors so that doors do not open uncontrollably.
 - c. Gasket: Neoprene, applied around entire perimeters of panel frames.

3. Windows:
 - a. Construction: Fabricate windows in access panels and doors of double-glazed, safety glass with an airspace between panes and sealed with interior and exterior rubber seals.
 - b. Size: Minimum 6 inches, square or round.
4. Locations and Applications:
 - a. Fan Section: Doors, with windows.
 - b. Coil Section: Panels.
 - c. Access Section: Doors.
 - d. Access Sections Immediately Upstream and Downstream of Coil Sections: Doors, with windows.
 - e. Damper Section: Doors, with windows.
 - f. Filter Section: Doors large enough to allow periodic removal and installation of filters.
 - g. Mixing Section: Doors, with windows.
5. Service Lights: LED vaporproof luminaire with individual switched junction box located outside, adjacent to each access door and panel.
 - a. Locations: Each section accessed with door with viewing window.

J. Condensate Drain Pans:

1. Construction:
 - a. Double-wall, 300 series stainless-steel sheet with space between walls filled with foam insulation and moisture-tight seal if integrated into unit flooring, otherwise single-wall, 300 series stainless-steel sheet may be used.
2. Drain Connection:
 - a. Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
3. Slope: Minimum 0.125-in./ft. slope, to comply with ASHRAE 62.1, in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and from humidifiers and to direct water toward drain connection.
4. Length: Extend drain pan downstream from leaving face for distance to comply with ASHRAE 62.1.
5. Width: Entire width of water producing device.
6. Depth: A minimum of 2 inches deep.
7. Formed sections.
8. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

2.4 TEST AND BALANCING PORTS

- A. Provide a permanent factory-installed sealable port on each section of unit to allow for testing and balancing of system, except where port would be blocked by filters or coils.

2.5 FAN, DRIVE, AND MOTOR SECTION

- A. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.

- B. Fans: Centrifugal, galvanized steel; mounted on solid-steel shaft.
 - 1. Shafts: With field-adjustable alignment.
 - a. Turned, ground, and polished hot-rolled steel with keyway.
 - 2. Shaft Bearings:
 - a. Prelubricated and Sealed, Ball Bearings: Self-aligning, pillow-block type with an L-50 rated life of 200,000 hours according to ABMA 9.
 - 3. Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.
 - a. Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.
 - 4. Housings, Plenum Fans: Steel frame and panel; fabricated without fan scroll and volute housing. Provide inlet screens for Type SWSI fans.
 - 5. Plenum Fan Arrays: Contained or Uncontained as defined in AHRI 430. Steel or aluminum frame with inlet cone and structural framing around each fan built into an array of multiple fans. Provide backdraft dampers at each fan to prevent short circuiting of flow if one fan is not operating.
 - 6. Airfoil, Centrifugal Fan Wheels (Plenum Fan Wheels): Smooth-curved inlet flange, backplate, and hollow die-formed airfoil-shaped blades continuously welded at tip flange and backplate; steel hub riveted to backplate and fastened to shaft with setscrews.
 - 7. Mounting: For internal vibration isolation. Factory-mount fans with manufacturer's standard vibration isolation mounting devices having a minimum static deflection as required to maintain 90% of isolation efficiency.
- C. Drive, Direct: Factory-mounted, direct drive.
- D. Motors:
 - 1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 3. Provide each motor with factory mounted AEGIS shaft grounding rings.
- E. Comply with Section 230925 "Variable-Frequency Motor Controllers."

2.6 COIL SECTION

- A. General Requirements for Coil Section:
 - 1. Comply with AHRI 410.
 - 2. Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
 - 3. Coils shall not act as structural component of unit.
- B. Heating Coils:
 - 1. Electrical Coils, Controls, and Accessories: Comply with UL 1995.

- a. Casing Assembly: Slip-in or Flanged type with galvanized-steel frame.
- b. Open Heating Elements: Resistance wire of 80 percent nickel and 20 percent chromium supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized-steel frame.
- c. Overtemperature Protection: Disk-type, automatically resetting, thermal-cutout, safety device; serviceable through terminal box without removing heater from coil section.
- d. Secondary Protection: Load-carrying, manually resetting or manually replaceable, thermal cutouts; factory wired in series with each heater stage.
- e. Control Panel: Unit mounted with disconnecting means and overcurrent protection.
 - 1) Magnetic contactor.
 - 2) Solid-state, stepless pulse (SCR) controller.
 - 3) Time-delay relay.
 - 4) Airflow proving switch.

2. Hot-Water Coils: Continuous circuit, Self-draining, and Cleanable.

- a. Piping Connections: Threaded on 1-1/2" and smaller, Flanged on 2" and larger, same end of coil.
- b. Tube Material: Copper.
- c. Fin Type: Plate.
- d. Fin Material: Aluminum.
- e. Fin and Tube Joint: Mechanical bond or Silver brazed.
- f. Headers:
 - 1) Seamless copper tube with brazed joints, prime coated.
- g. Frames: Channel frame, 0.079-inch- thick, galvanized steel.
- h. Coil Working-Pressure Ratings: 200 psig, 325 deg F.
- i. Coating: On units with outside air percentage greater than 30%, coils shall be provided with a factory applied heresite corrosion protection coating or equal with at least 6000 hr salt spray protection per ASTM B 117.

C. Cooling Coils:

1. Chilled-Water Coil: Continuous circuit, Self-draining, and Cleanable.

- a. Piping Connections: Threaded on 1-1/2" and smaller, Flanged on 2" and larger, same end of coil .
- b. Tube Material: Copper.
- c. Tube Thickness: 020 inches.
- d. Fin Type: Plate.
- e. Fin Material: Aluminum.
- f. Fin and Tube Joint: Mechanical bond or Silver brazed.
- g. Headers:
 - 1) Seamless copper tube with brazed joints, prime coated.
- h. Frames: Channel frame, 0.0625-inch- thick, stainless steel.
- i. Coatings: On units with outside air percentage greater than 30%, coils shall be provided with a factory applied heresite corrosion protection coating or equal with at least 6000 hr salt spray protection per ASTM B 117.
- j. Working-Pressure Ratings: 200 psig, 325 deg F.

2. Refrigerant Coil:

- a. Tubes: Copper.

- b. Fins:
 - 1) Material: Aluminum.
- c. Fin and Tube Joints: Mechanical bond.
- d. Headers: Seamless-copper headers with brazed connections.
- e. Frames: Stainless steel.
- f. Coatings: On units with outside air percentage greater than 30%, coils shall be provided with a factory applied heresite corrosion protection coating or equal with at least 6000 hr salt spray protection per ASTM B 117.
- g. Ratings: Designed, tested, and rated according to ASHRAE 33 and AHRI 410.
 - 1) Working Pressure: Minimum 300 psig.

2.7 AIR FILTRATION SECTION

A. Panel Filters:

- 1. Description: Pleated factory-fabricated, self-supported, disposable air filters with holding frames.
- 2. Filter Unit Class: UL 900.
- 3. Media: Interlaced glass, synthetic or cotton fibers coated with nonflammable adhesive.
- 4. Filter-Media Frame: Beverage board with perforated metal retainer, or metal grid, on outlet side.

B. Bag Filters:

- 1. Description: Factory-fabricated, dry, extended-surface, self-supporting filters with holding frames in steel, basket-type retainers.
- 2. Filter Unit Class: UL 900.
- 3. Media: Fibrous material, coated with antimicrobial agent, constructed so individual pockets are maintained in tapered form by flexible internal supports under rated-airflow conditions.
- 4. Filter-Media Frame: Galvanized steel.

C. Cartridge Filters:

- 1. Description: Factory-fabricated, adhesive-coated disposable, packaged air filters with media perpendicular to airflow, and with holding frames.
- 2. Filter Unit Class: UL 900.
- 3. Media: Fibrous material, coated with antimicrobial agent, constructed so individual pleats are maintained in pleated form under rated-airflow conditions by corrugated aluminum separators.
- 4. Filter Media Frame: Galvanized steel.

D. Adhesive, Sustainability Projects: As recommended by air-filter manufacturer and with a VOC content of 80 g/L or less.

E. Side-Access Filter Mounting Frames:

- 1. Particulate Air Filter Frames: Match inner casing and outer casing material, and insulation thickness. Galvanized steel track.
 - a. Prefilters: Incorporate an integral 2-inch- thick track with same access as primary filter.
 - b. Sealing: Incorporate positive-sealing device to ensure seal between gasketed material on channels to seal top and bottom of filter cartridge frames to prevent bypass of unfiltered air.
- 2. HEPA Filter Frames:

- a. Frames: Match inner casing and outer casing material, and insulation thickness. Aluminum or Stainless steel track.
 - b. Sealing: Incorporate positive-sealing clamping device on each filter between gasket or gel seal on all sides of filter cartridge frames to prevent bypass of unfiltered air.
- F. Provide flush mounted factory installed filter-gauge for each filter section.

2.8 DAMPERS

- A. Dampers: Comply with requirements in Section 230923.12 "Control Dampers."
- B. Outdoor- and Return-Air Dampers: Low-leakage, double-skin, airfoil-blade, aluminum dampers with compressible jamb seals and extruded-vinyl blade edge seals in opposed-blade arrangement with zinc-plated steel operating rods rotating in stainless steel sleeve or sintered bronze or nylon bearings mounted in a single aluminum frame, and with operating rods connected with a common linkage. Leakage rate shall not exceed 4 cfm/sq. ft. at 1-inch wg and 8 cfm/sq. ft. at 4-inch wg, tested, rated, and labeled in accordance with AMCA 511.
- C. Damper Operators: Comply with requirements in Section 230923.12 "Control Dampers."
- D. Combination Filter and Mixing Section:
 - 1. Cabinet support members shall hold 2-inch- thick, pleated, flat, permanent or throwaway filters.

2.9 AIR-TO-AIR ENERGY RECOVERY UNITS

- A. Heat Wheels:
 - 1. Casing:
 - a. Galvanized steel, stainless steel, or aluminum with manufacturer's standard finish.
 - b. Integral purge section limiting carryover of exhaust air to between 0.05 percent at 1.6-inch wg and 0.20 percent at 4-inch wg differential pressure.
 - c. Casing seals on periphery of rotor, on duct divider, and on purge section.
 - d. Support rotor on grease-lubricated ball bearings with extended grease fittings. Mount horizontal wheels on tapered roller bearing.
 - 2. Rotor - Aluminum, Metallic, or Polymer: Segmented wheel, strengthened with radial spokes impregnated with nonmigrating, water-selective, 3-angstrom molecular-sieve desiccant coating.
 - 3. Heat-Exchanger Prefilters: 2 inches thick, disposable MERV 8.
 - 4. Drive: Fractional horsepower motor and gear reducer, with speed changed by variable-frequency controller. Permanently lubricated wheel bearings with an L-10 400,000 hours.
 - 5. Controls:
 - a. Starting relay, factory mounted and wired, and manual motor starter for field wiring.
 - b. For Climate Zones 3 and above as defined by ASHRAE provide variable-frequency controller, factory mounted and wired, with exhaust-air sensor to vary rotor speed and maintain exhaust temperature above freezing.
 - c. Pilot-Light Indicator: Display rotor rotation and speed.
 - d. Speed Settings: Adjustable settings for maximum and minimum rotor speed limits.
- B. Fixed-Plate Total Heat Exchangers:
 - 1. Casing: Aluminum.

2. Plates: Evenly spaced and sealed and arranged for counter or cross airflow.
3. Plate Material: Chemically treated paper or polymer membrane with selective hygroscopicity and moisture permeability, and gas barrier properties.
4. Heat-Exchanger Prefilters: 2 inches thick, disposable MERV 8.

2.10 UV-C LAMP SYSTEMS

A. Description:

1. UV-C lamp system consisting of power supply, power supply housing, wiring, UV lamp(s), lamp plug, lamp plug protector, encapsulated lamp, and lamp holder used for UV germicidal irradiation of cooling coil and condensate drain pan.
2. Factory installed and preengineered.

B. Standard: UL Category Code ABQK, HVAC accessories, air-duct mounted.

C. Lamps: High output, hot cathode.

D. Lamp-Holder Construction:

1. UV- and moisture-resistant materials and designed to connect the lamp to the plug.
2. Adjustable positioning.

E. Lamp-Clamp Construction:

1. UV- and moisture-resistant materials, water-tight connection.
2. Adjustable positioning.

F. Lamp Protection: Hermetically sealed to provide protection against lamp breakage and to ensure lamp contents from a broken lamp are contained.

G. Lamp Output: UV-C energy, primarily at the 254-nm wavelength with a 360-degree energy distribution.

H. Access Door Interlocks: Automatic disconnect on all access doors into UV-installed casing sections to shield servicing personnel from contact with light.

I. Power Supply: UL-listed, single-point electrical connection with service disconnect.

J. Power Consumption: Maximum of **15 W/sq. ft.**

2.11 MATERIALS

A. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for steel sheet.

B. Stainless Steel:

1. Manufacturer's standard grade for casing but no less than 300 series.
2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture but no less than 300 series..

- C. Galvanized Steel: ASTM A653/A653M.
- D. Aluminum: ASTM B 09.
- E. Corrosion-Resistant Coating: Coat with a corrosion-resistant coating capable of withstanding a 6,000 or 10,000-hour (dependent on application) salt-spray test according to ASTM B117.
 - 1. Standards:
 - a. ASTM B117 for salt spray.
 - b. ASTM D2794 for minimum impact resistance of 100 in-lb.
 - c. ASTM B3359 for cross hatch adhesion of 5B.
 - 2. Application: Immersion or Spray.
 - 3. Thickness: 1 mil.
 - 4. Gloss: Minimum gloss of 60 on a 60-degree meter.

2.12 SOURCE QUALITY CONTROL

- A. AHRI 430 Certification: Test, rate, and label air-handling units and their components in accordance with AHRI 430.
- B. AHRI 1060 Certification: Test, rate, and label air-handling units that include air-to-air energy recovery devices in accordance with AHRI 1060.
- C. AHRI 260 Sound Performance Rating Certification: Test, rate, and label in accordance with AHRI 260.
- D. Fan Energy Index (FEI): Test in accordance with AMCA 210 and rate in accordance with AMCA 99, AMCA 207, and AMCA 208.
- E. Fan Operating Limits: Classify fans in accordance with AMCA 99, Section 14.
- F. Water Coils: Factory tested to 300 psig according to AHRI 410 and ASHRAE 33.
- G. Refrigerant Coils: Factory tested to minimum 450-psig internal pressure and to minimum 300-psig internal pressure while underwater, according to AHRI 410 and ASHRAE 33.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for hydronic and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Equipment Mounting:

1. Install air-handling units on cast-in-place concrete equipment bases. Coordinate sizes and locations of concrete bases with actual equipment provided. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation devices specified in Section 230548 "Vibration Controls for HVAC."

B. Suspended Units: Suspend and brace units from structural-steel support frame using threaded steel rods and spring hangers. Comply with requirements for vibration isolation devices specified in Section 230548 "Vibration Controls for HVAC."

C. Arrange installation of units to provide access space around air-handling units for service and maintenance.

D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.

E. Install filter-gauge, static-pressure taps upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum in accessible position. Provide filter gauges on filter banks, installed with separate static-pressure taps upstream and downstream of filters.

F. Connect duct to air-handling units with flexible connections. Comply with requirements in Section 233300 "Air Duct Accessories."

3.3 PIPING CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to air-handling unit, allow for service and maintenance.

C. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.

D. Connect condensate drain pans using full pipe size, ASTM B88, Type L copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

E. Hot- and Chilled-Water Piping: Comply with applicable requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.

F. Refrigerant Piping: Comply with applicable requirements in Section 232300 "Refrigerant Piping." Install shutoff valve and union or flange at each supply and return connection.

3.4 ELECTRICAL CONNECTIONS

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

- C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."

3.5 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that shipping, blocking, and bracing are removed.
 - 3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
 - 4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
 - 5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
 - 6. Verify that outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
 - 7. Comb coil fins for parallel orientation.
 - 8. Verify that proper thermal-overload protection is installed for electric coils.
 - 9. Install new, clean filters.
 - 10. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.
- B. Starting procedures for air-handling units include the following:
 - 1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm.
 - 2. Measure and record motor electrical values for voltage and amperage.
 - 3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.7 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

- C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.8 CLEANING

- A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

3.9 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Air-handling unit or components will be considered defective if unit or components do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

END OF SECTION 23 73 13

DIVISION 26

SECTION 26 00 10 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL

- A. Basic Requirements: The Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. General Provisions: Provide all labor, materials, equipment, and incidentals required to make ready for use complete electrical systems as specified herein and shown on the drawings.
- C. Provide and Install: The word "provide" where used on the Drawings or in the Specifications shall mean "furnish, install, mount, connect, test, complete, and make ready for operation". The word "install" where used on the Drawings or in the Specifications shall mean "mount, connect, test, complete, and make ready for operation". Perform work required by, and in accordance with, the Contract Documents.
- D. Installation: Provide and place in satisfactory condition, ready for proper operation, raceways, wires, cables, and other material needed for all complete electrical systems required by the Contract Documents. Additional raceways and wiring shall be provided to complete the installation of the specific equipment provided. Include auxiliaries and accessories for complete and properly operating systems. Provide electrical systems and accessories to comply with the NEC, state and local codes and ordinances. It is the intent of these Specifications that the electrical systems be suitable in every way for the use intended. Material and work which is incidental to the work of this Contract shall be provided at no additional cost to the Contract.
- E. Field Connections: Provide field connections to remote equipment and control panels provided under other Divisions of these Specifications. Provide raceway, wire, and interconnections between equipment, transmitters, local indicators, and receivers. Provide 120V and low voltage surge protection equipment in accordance with Section 16709 at equipment as required. Install field connections to "packaged" equipment provided under other Divisions of these Specifications.

1.2 SCOPE OF WORK

- A. General: Provide labor, materials, permits, inspections and re-inspection fees, tools, equipment, transportation, insurance, temporary protection, temporary power and lighting, supervision and incidental items essential for proper installation and operation of the Electrical systems indicated in the Contract Documents. Provide materials not specifically mentioned or indicated but which are usually provided or are essential for proper installation and operation of the Electrical systems indicated in the contract documents.
- B. Notices: Give notices, file Plans, pay fees, and obtain permits and approvals from authorities having jurisdiction. Include all fees in the Bid Price.

1.3 INTERPRETATION OF DRAWINGS

- A. General: The Drawings are diagrammatic and are not intended to show exact locations of Raceway runs, outlet boxes, junction boxes, pull boxes, etc. The locations of equipment, appliances, fixtures, Raceways, outlets, boxes and similar devices shown on the Drawings are approximate only. Exact locations shall be determined and coordinated in the field. The right is reserved to change, without additional cost, the location of any outlet within the same room or general area before it is permanently installed. Obtain all information relevant to the placing of electrical work and in case of interference with other work, proceed as directed by the Engineer.
- B. Discrepancies: Notify the Architect of any discrepancies found during construction of the project. The Engineer will provide written instructions as to how to proceed with that portion of work. If a conflict exists between the Contract Documents and an applicable code or standard, the most stringent requirement shall apply.

- C. Wiring: Each three-phase circuit shall be run in a separate Raceway unless otherwise shown on the Drawings. Unless otherwise accepted by the Engineer, Raceway shall not be installed exposed. Where circuits are shown as "home-runs" all necessary fittings, supports, and boxes shall be provided for a complete raceway installation.
- D. Layout: Circuit layouts are not intended to show the number of fittings, or other installation details. Connections to equipment shall be made as required, and in accordance with the accepted shop and manufacturer's setting drawings.
- E. Coordination: Coordinate final equipment locations with drawings or other disciplines. Layout before installation so that all trades may install equipment in available space. Provide coordination as required for installation in a neat and workmanlike manner.

1.4 EQUIPMENT SIZE AND HANDLING

- A. Coordination: Investigate each space in the structure through which equipment must pass to reach its final location. If necessary, ship the equipment in sections of specific sizes to permit the passing through the necessary areas within the structure.
- B. Handling: Equipment shall be kept upright at all times. When equipment has to be tilted for ease of passage through restricted areas during transportation, the manufacturer shall be required to brace the equipment suitably, to insure that the tilting does not impair the functional integrity of the equipment.

1.5 RECORD DRAWINGS

- A. Production: The Contractor shall provide two (2) sets of black or blue line on white drawings to maintain and submit record "As-Built Documents". Label each sheet of the Record Document set with "Project Record Documents" with company name of the installing contractor in stamped or printed letters. One set shall be maintained at the site and at all times be accurate, clear, and complete. These drawings shall be available at all times to the Architect's field representatives.
- B. Recording: Record information concurrent with construction progress. Make entries within 24 hours upon receipt of information. The "As-Built" drawings shall accurately reflect installed electrical work specified or shown on the Contract Documents.
- C. Completion: At the completion of the Work, transfer changes with a colored pencil onto the second set and submit to the Engineer. The "As-Built" drawings shall be made available to the Engineer to make the substantial completion punch list.
- D. Final: Upon Contractor's completion of the Engineer's final punch list, transfer all "As-Built" conditions and all requirements by the Engineer to a reproducible set of drawings and CAD files. Submit drawings and CAD disks for review and acceptance. The Contractor shall provide updated disks which include final As-Built conditions.

1.6 ABBREVIATIONS

- A. Abbreviations: The following abbreviations or initials may be used:
A/C Air Conditioning
AC..... Alternating Current
ABV CLG..... Above Ceiling
ADA Americans with Disabilities Act
AF Ampere Frame
AFF..... Above Finished Floor
AFG Above Finished Grade
AHU Air Handler Unit
AIC Amps Interrupting Capacity
AL..... Aluminum
AMP Ampere
ANSI..... American National Standards Institute

ASA	American Standards Association
AT	Ampere Trip
ATS.....	Automatic Transfer Switch
AUX	Auxiliary
AWG.....	American Wire Gauge
BC	Bare Copper
BIL.....	Basic Impulse Level
BMS.....	Building Management System
BRKR or BKR.....	Breaker
CAB	Cabinet
C	Conduit or Raceway
CB.....	Circuit Breaker
CBM	Certified Ballast Manufacturers
CCTV.....	Closed Circuit Television
CKT	Circuit
CLEC.....	Clock Equipment Cabinet
CLG	Ceiling
CO.....	Conduit or Raceway Only
COAX.....	Coaxial Cable
COND	Conductor
CONN.....	Connection
CPU	Central Processing Unit
CRT	Cathode Ray Terminal (Video display terminal)
CT	Current Transformer
CU.....	Copper
CW	Cold Water
DC.....	Direct Current
DDC.....	Direct Digital Control
DEG	Degree
DISC.....	Disconnect
DO	Draw Out
DN	Down
DPST	Double Pole Single Throw
EMT.....	Electrical Metallic Tubing
EO.....	Electrically Operated
EOL	End of Line Resistor
EWC	Electric Water Cooler
FAAP.....	Fire Alarm Annunciator Panel
FACP	Fire Alarm Control Panel
FCU	Fan Coil Unit
FLA.....	Full Load Amperes
FM	Factory Mutual
GF	Ground Fault
GFCI.....	Ground Fault Circuits Interrupter
GND	Ground
HOA	Hand-Off-Automatic
HORIZ.....	Horizontal
HP	Horsepower
IC	Intercom
ICU	Intensive Care Unit
IEEE.....	Institute of Electrical and Electronic Engineers
IES	Illuminating Engineering Society
IMC.....	Intermediate Metallic Raceway
IN	Inches
IT	Instantaneous Trip
IPCEA.....	Insulated Power Cable Engineers Association
JB	Junction Box
KCMIL	Thousand Circular Mills
KV	Kilovolt
KVA	Kilo-Volt-Amps
KW	Kilowatts
LBS.....	Pounds

LED	Light Emitting Diode
LT	Light
LTD	Long Time Delay
LTT.....	Long Time Trip
LTG	Lighting
MAX.....	Maximum
MCB	Main Circuit Breaker
MCC	Motor Control Center
MCP.....	Motor Circuit Protector
MIC.....	Microphone
MIN	Minimum
MLO	Main Lugs Only
MTD	Mounted
MTG	Mounting
MUX.....	Multiplex (Transponder) Panel
MVA.....	Mega Volt Amps
N	Neutral
NC.....	Normally Closed
NEC	National Electrical Code
NECA	National Electrical Contractors Association
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NIC	Not in Contract
NF	Non Fused
NL.....	Non Linear
NO	Number or Normally Open
#	Number
Ø	Phase
OL.....	Overload
OSHA	Occupational Safety and Health Administration
P.....	Pole
PB	Pullbox
PIV.....	Post Indicator Valve
PNL.....	Panel
PR	Pair
PWR	Power
PF.....	Power Factor
PRI.....	Primary
PT	Potential Transformer
PVC	Polyvinylchloride
REF.....	Refrigerator
RGC or GRC	Rigid Galvanized Raceway
RMS.....	Root-Mean-Square
RPM.....	Revolutions Per Minute
RECPT.....	Receptacle
SCA	Short Circuit Amps
SD.....	Smoke Detector
SEC.....	Secondary
S/N.....	Solid Neutral
SPKR	Speaker
SPST	Single Pole Single Throw
SST	Solid State Trip
ST	Short Time Trip
STD.....	Short Time Delay
SW	Switch
SWGR.....	Switchgear
SWBD.....	Switchboard
TEL.....	Telephone
TTB.....	Telephone Terminal Board
TTC.....	Telephone Terminal Cabinet
TVEC.....	Television Equipment Cabinet
TYP.....	Typical
UL.....	Underwriters Laboratories

UON Unless Otherwise Noted
 V Volt
 VFD Variable Frequency Drive
 VSD Variable Speed Drive
 W Wire
 WP Weatherproof
 XFMR Transformer

1.7 CODES, FEES, AND STANDARDS

- A. Application: The codes, standards and practices listed herein generally apply to the entire project and specification sections. Other codes, standards or practices that are more specific will be referenced within a particular specification.
- B. Requirements: All materials and types of construction covered in the specifications will be required to meet or exceed applicable standards of manufacturer, testing, performance, and installation according to the requirements of UL, ANSI, NEMA, IEEE, and NEC referenced documents where indicated and the manufacturer's recommended practices. Requirements indicated on the contract documents that exceed but are not contrary to governing codes shall be followed.
- C. Compliance and Certification: The installation shall comply with the governing state and local codes or ordinances. The completed electrical installation shall be inspected and certified by applicable agencies that it is in compliance with codes.
- D. Applicability: The codes and standards and practices listed herein, and their respective dates are furnished as the minimum latest requirements.
 - 1. State of Florida
 - 2. Charlotte County
 - 3. City of Punta Gorda
- E. Utility Company: Comply with latest utility company regulations.
- F. State Code: Florida Administrative Code
- G. Building Code: Florida Building Code (2020).
- H. Standards: American Society of Mechanical Engineers
 - 1. ASME-A17.1 Elevator Code, plus Interpretations to Date.
- I. Manuals: Accessibility requirements manual Florida Department of Community Affairs.
- J. Labels: Materials and equipment shall be new and free of defects, and shall be U.L. listed, bear the U.L. label or be labeled or listed with an approved, nationally recognized Electrical Testing Agency. Where no labeling or listing service is available or desired for certain types of equipment, test data shall be submitted to validate that equipment meets or exceeds available standards.
- K. NFPA: National Fire Protection Association (NFPA) Standards
 - NFPA-13..... Standard for the Installation of Sprinkler Systems
 - NFPA-20..... Standard for the Installation of Stationary Pumps for Fire Protection
 - NFPA-54..... National Fuel Gas Code
 - NFPA-70..... National Electrical Code
 - NFPA-72..... National Fire Alarm Code
 - NFPA-75..... Standard for the Protection of Electronic Computer/Data Processing Equipment
 - NFPA-90A..... Standard for the Installation of Air Conditioning and Ventilating Systems
 - NFPA-101..... Life Safety Code
 - NFPA-110..... Emergency and Standby Power Systems
 - NFPA-780..... Installation of Lightning Protection Systems

1.8 INVESTIGATION OF SITE

- A. General: Before commencing work, verify existing conditions at the premises and examine adjoining work on which work is in anyway dependent.
- B. Responsibility: No waiver of responsibility for defective and inadequate work or additional cost as a result of existing conditions which should have been verified shall be considered unless notice of same has been filed by the Contractor and agreed to in writing by the Engineer before the bid date.
- C. Site Renovation: Verify and coordinate existing site raceways and pipes at any excavation on site. Provide hand-digging and required rerouting in areas of existing Raceways and pipes within bid price.
- D. All existing wiring that is to remain in renovated areas shall be made code compliant.

1.9 SUPERVISION OF THE WORK

- A. Supervision: Provide one field superintendent who has had a minimum of four (4) years previous successful experience on projects of comparable sizes, type and complexity. The Superintendent shall be present at all times when work is being performed. At least one member of the Electrical Contracting Firm shall hold a State Master Certificate of Competency.

1.10 COORDINATION

- A. General: Compare drawings and specifications with those of other trades and report any discrepancies between them to the Engineer. Obtain from the Engineer written instructions to make the necessary changes in any of the affected work. Work shall be installed in cooperation with other Trades installing interrelated work. Before installation, Trades shall make proper provisions to avoid interferences in a manner approved by the Engineer.
- B. Provide all required coordination and supervision where work connects to or is affected by work of others, and comply with all requirements affecting this Division. Work required under other divisions, specifications or drawings to be performed by this Division shall be coordinated with the Contractor and such work performed at no additional cost to Owner including but not limited to electrical work required for:
 - 1. Door hardware
 - 2. Roll-up doors
 - 3. Roll-up grilles
 - 4. Signage
 - 5. Fire shutters
 - 6. Elevators
 - 7. Sliding or automatic doors
 - 8. Mechanical Division of the Specifications
 - 9. Landscape Architect drawings
 - 10. Lifts
 - 11. Interior design drawings
 - 12. Fountains
 - 13. Millwork design drawings and shop drawings
- C. Obtain set of Contract Documents from Owner's Authorized Representative or Contractor for all areas of work noted above and include all electrical work in bid whether included in Division 26 Contract Documents or not.
- D. Secure approved shop drawings from all required disciplines and verify final electrical characteristics before roughing power feeds to any equipment. When electrical data on approved shop drawings differs from that shown or called for in Construction Documents, make adjustments to the wiring, disconnects, and branch circuit protection to match that required for the equipment installed.
- E. Damage from interference caused by inadequate coordination shall be corrected at no additional cost to the Owner.

- F. Adjustments: Locations of raceway and equipment shall be adjusted to accommodate the work with interferences anticipated and encountered. Determine the exact routing and location of systems prior to fabrication or installation.
 - G. Priorities: Lines which pitch shall have the right of way over those which do not pitch. For example, plumbing drains shall normally have the right of way. Lines whose elevations cannot be changed shall have the right of way over lines whose elevations can be changed.
 - H. Modifications: Offsets and changes of direction in raceway systems shall be made to maintain proper headroom and pitch of sloping lines whether or not indicated on the drawings. Provide elbows, boxes, etc., as required to allow offsets and changes to suit job conditions.
 - I. Replacement: Work shall be installed in a way to permit removal (without damage to other parts) of other system components provided under this Contract requiring periodic replacement or maintenance. Raceway shall be arranged in a manner to clear the openings of swinging overhead access doors as well as ceiling tiles.
 - J. Layout: The Contract Drawings are diagrammatic only intending to show general runs and locations of raceway and equipment, and not necessarily showing required offsets, details and accessories and equipment to be connected. Work shall be accurately laid out with other Trades to avoid conflicts and to obtain a neat and workmanlike installation, which will afford maximum accessibility for operation, maintenance and headroom.
 - K. Contract Conflicts: Where discrepancies exist in the Scope of Work as to what Trade provides items such as starters, disconnects, flow switches, etc. such conflicts shall be coordinated between the divisions involved. It is the intent of the Contract Documents that all work shall be provided complete as one bid price.
 - L. Drawing Conflicts: Where drawing details, plans or specification requirements are in conflict and where sizes of the same item run are shown to be different within the contract documents, the most stringent requirement shall be included in the Contract. Systems and equipment called for in the specification or as shown on the drawings shall be provided as if it was required by both the drawings and specifications. Prior to ordering or installation of any portion of work, which appears to be in conflict, such work shall be brought to Engineer's attention for direction as to what is to be provided.
 - M. It is the responsibility of this Contractor to coordinate the exact required location of floor outlets, floor ducts, floor stub-ups, etc. with Owner's Authorized Representative and Designer (and receive their approval) prior to rough-in. Locations indicated in Contract Documents are only approximate locations.
 - N. The Contract Documents describe specific sizes of switches, breakers, fuses, Raceways, conductors, motor starters and other items of wiring equipment. These sizes are based on specific items of power consuming equipment (heaters, lights, motors for fans, compressors, pumps, etc.). Coordinate the requirements of each load with each load's respective circuitry shown and with each load's requirements as noted on its nameplate data and manufacturer's published electrical criteria. Adjust circuit breaker, fuse, Raceway, and conductor sizes to meet the actual requirements of the equipment being provided and installed and change from single point to multiple points of connection (or vice versa) to meet equipment requirements. Changes shall be made at no additional cost to the Owner.
 - O. Working Clearances: Minimum working clearances about electrical equipment shall be as referenced in the applicable edition NEC Article 110, and shall include equipment installed in ceiling spaces.
- 1.11 DEMOLITION
- A. General: Relocate existing equipment and reroute existing raceways in areas being renovated as required to facilitate the installation of the new systems. The Owner shall require continuous operation of the existing systems, while demolition, relocation work or new tie-ins are performed.
 - B. Coordination: Prior to any deactivation, relocation or demolition work, arrange a conference with the Engineer and the Owner's representative in the field to inspect each of the items to be deactivated, removed or relocated. Care shall be taken to protect equipment designated as being relocated and reused or equipment remaining in operation and integrated with the new systems.

- C. Provisions: Deactivation, relocation, and temporary tie-ins shall be provided by the Contractor. Demolition, removal and the legal disposal of demolished materials shall be provided by the Contractor.
- D. Owner's Salvage: The Owner reserves the right to inspect the material scheduled for removal and salvage any items he deems usable as spare parts.
- E. Phasing: The Contractor shall perform work in phases as directed by the Architect to suit the project progress schedule, as well as the completion date of the project.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Specified Method: Where several brand names, make or manufacturers are listed as acceptable each shall be regarded as equally acceptable, based on the design selection but each must meet all specification requirements. Where a manufacturer's model number is listed, this model shall set the standard of quality and performance required. Where no brand name is specified, the source and quality shall be subject to Engineer's review and acceptance. Where manufacturers are listed, one of the listed manufacturers shall be submitted for acceptance. No substitutions are permitted.
- B. Certification: When a product is specified to be in accordance with a trade association or government standard requested by the Engineer, Contractor shall provide a certificate that the product complies with the referenced standard. Upon request of Engineer, Contractor shall submit supporting test data to substantiate compliance.
- C. Basis of Bid: Each bidder represents that his bid is based upon the manufacturer's, materials, and equipment described in the Contract Documents.
- D. Space Requirements: Equipment or optional equipment shall conform to established space requirements within the project. Equipment which does not meet space requirements, shall be replaced at no additional expense to the Contract. Modifications of related systems shall be made at no additional expense to the Contract. Submit modifications to the Engineer for acceptance.
- E. Samples: Samples are to be submitted for items requested within Specification Sections to determine that the item meets specifications and requirements before being accepted for use on Project. Samples shall be submitted within 30 days after the award of the contract. Each sample shall be tagged, labeled, or marked, "Sample of for (Project). Accompany samples with copy, in duplicate of manufacturer's instructions regarding installation, and maintenance.
- F. All screws, bolts, washers, and other fasteners used in supporting fixtures, conduit, outlets will be fabricated from rust-resistant metal and will be of a common replacement design type. No rivets or other non-replaceable type fastener will be permitted. The use of tie wire outside of slab work is not acceptable. Gun power set anchors are not permitted.

2.2 SHOP DRAWINGS

- A. General: Shop drawings shall be submitted for every item listed within the Submittals section each individual specification section. One copy shall be submitted to the engineer prior to ordering equipment. Refer to Basis of approval paragraph.
- B. Responsibility: It is the Contractors responsibility to provide material in accordance with the plans and specifications. Material not provided in accordance with the plans and specifications shall be removed and replaced at the Contractors expense.
- C. Official Record: The shop drawing submittal shall become the official record of the materials to be installed. If materials are installed which do not correspond to the record submittal they shall be removed from the project without any additional cost or delays in construction completion.
- D. Information: The shop drawing record submittal shall include the following information to the extent applicable to the particular item;
 - 1. Manufacturer's name and product designation or catalog number.
 - 2. Standards or specifications of ANSI, ASTM, ICEA, IEEE, ISA, NEMA, NFPA, OSHA, UL, or other organizations, including the type, size, or other designation.

3. Dimensioned plan, sections, and elevations showing means for mounting, raceway connections, and grounding, and showing layout of components.
 4. Materials and finish specifications, including paints.
 5. List of components including manufacturer's names and catalog numbers.
 6. Internal wiring diagram indicating connections to components and the terminals for external connections.
 7. Manufacturer's instructions and recommendations for installation, operation, and maintenance.
 8. Manufacturer's recommended list of spare parts.
 9. Provide 1/4" = 1'-0" enlarged electrical room layout drawings for all electrical rooms. All equipment shall be indicated at actual size of equipment being provided. All dimensions and required working clearances shall be shown.
- E. Preparation: Prior to submittal, shop drawings shall be checked for accuracy and contract requirements. Shop drawings shall bear the date checked and shall be accompanied by a statement that the shop drawings have been examined for conformity to Specifications and Drawings. This statement shall also list discrepancies with the Specifications and Drawings. Shop drawings not so checked and noted shall be returned to Contractor unreviewed.
- F. Basis of Review: Approval is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Contractor is responsible for quantities, dimensions, fabrication processes, and construction techniques.
- G. Responsibility: The responsibility that dimensions are confirmed and correlated with proper coordination of other trades shall be included as part of the Contract Documents. The responsibility and the necessity of providing materials and workmanship required by the Specifications and Drawings which may not be indicated on the shop drawings shall be included as part of the Contract Documents. The Contractor is responsible for any delays in job progress occurring directly or indirectly from late submissions or re-submissions of shop drawings, product data, or samples.
- H. Ordering Equipment: No material shall be ordered or shop work started until the Engineer has officially received the shop drawings record submittal and has formally released the Contractor for submittal requirements.
- I. Brochure Requirements: Submit Technical Information Brochures at the start of construction or no later than 30 days after Award of the Contract. Each brochure shall consist of an adequately sized, hardcover, 3-ring binder for 8-1/2" X 11" sheets. Provide correct designation on outside cover and on end of brochure. When one binder is not enough to adequately catalog all data, an additional binder shall be submitted.
- J. Brochure Contents: First sheet in the brochure shall be a photocopy of the Electrical Index pages in these specifications. Second sheet shall be a list of Project Addresses for this project. Third sheet shall list Project Information. Provide reinforced separation sheets tabbed with the appropriate specification reference number and typed index for each section in the Electrical Schedule. Technical Information consisting of marked catalog sheets or shop drawings shall be inserted in the brochure in proper order on all items specified and shown on drawings. At the end of the brochure, provide and insert a copy of the specifications for this Division and all addenda applicable to this Division.
- K. Contractor's Review: Review the brochures before submitting to the Engineer. No request for payment shall be considered until the brochure has been reviewed, stamped and submitted for review.
- L. Cost: Submit cost breakdown on work in the Technical Information Brochures. The cost of material and labor for each item shall be indicated. The cost of fittings and incidentals are not required.
- M. Title Drawings: Title drawings to include identification of project and names of Architect, Engineer, Contractors, and/or supplier, data, number sequentially and indicate in general;
1. Fabrication and Erection dimensions.
 2. Arrangements and sectional views.
 3. Necessary details, including complete information for making connections with other work.
 4. Kinds of materials and finishes.
 5. Descriptive names of equipment.
 6. Modifications and options to standard equipment required by the contract.

7. Leave blank area, size approximately 4 by 2-1/2 inches, near title block (for Engineer's stamp imprint).
8. In order to facilitate review of shop drawings, they shall be noted, indicating by cross-reference the contract drawings, notes, and specification paragraph numbers where items occur in the contract documents.
9. See specific sections of specifications for further requirements.

- N. Technical Data: Submit technical data verifying that the item submitted complies with the requirements of the specifications. Technical data shall include manufacturer's name and model number, dimensions, weights, electrical characteristics, and clearances required. Indicate optional equipment and changes from the standard item as called for in the specifications. Provide drawings, or diagrams, dimensioned and in correct scale, covering equipment, showing arrangement of components and overall coordination.
- O. Same Manufacturer: In general, relays, contactors, starters, motor control centers, switchboards, panelboards, dry type transformers, disconnect switches, circuit breakers, manual motor starter switches, etc., shall be supplied and manufactured by the same manufacturer. This requirement shall apply to same type of electrical components specified in other Divisions. Panelboards, switchboards, breakers, etc will match the existing building standard equipment.

2.3 EQUIPMENT, MATERIALS, AND SUPPORTS

- A. General: Each item of equipment or material shall be manufactured by a company regularly engaged in the manufacture of the type and size of equipment, shall be suitable for the environment in which it is to be installed, shall be approved for its purpose, environment, and application, and shall bear the UL label.
- B. Installation Requirements: Each item of equipment or material shall be installed in accordance with instructions and recommendations of the manufacturer, however, the methods shall not be less stringent than specified herein.
- C. Required Accessories: Provide all devices and materials, such as expansion bolts, foundation bolts, screws, channels, angles, and other attaching means, required to fasten enclosures, raceways, and other electrical equipment and materials to be mounted on structures which are existing or new.
- D. Protection: Electrical equipment shall at all times during construction be adequately protected against mechanical injury or damage by the elements. Equipment shall be stored in dry permanent shelters. If apparatus has been damaged, such damage shall be repaired at no additional cost or time extension to the Contract. If apparatus has been subject to possible injury, it shall be thoroughly cleaned, dried out and put through tests as directed by the Manufacturer and Engineer, or shall be replaced, if directed by the Engineer, at no additional cost to the Contract.

2.4 IDENTIFICATION OF EQUIPMENT

- A. General: Electrical items shall be identified as specified in the Contract Documents. Such identification shall be in addition to the manufacturer's nameplates and shall serve to identify the item's function and the equipment or system, which it serves or controls. Refer to Identification Section of the specifications for additional information.

2.5 CONCRETE PADS

- A. General: Provide reinforced concrete pads for floor mounted electrical equipment. Unless otherwise noted, pads shall be nominal four (4) inches high and shall exceed dimensions of equipment being set on them, including future sections, by six (6) inches on all sides, except when equipment is flush against a wall, then the side or sides against the wall shall be flush with the equipment. Chamfer top edges 1/2". Trowel surfaces smooth. Reinforce pads with #5 reinforcing bars at 24" centers each way, unless specifically detailed on drawings.

2.6 SURFACE MOUNTED EQUIPMENT

- A. General: Surface mounted fixtures, outlets, cabinets, panels, etc. shall have a factory-applied finish or shall be painted as accepted by Engineer. Raceways and fittings, where allowed to be installed surface mounted, shall be painted to match the finish on which it was installed. Paint shall be in accordance with other applicable sections of these specifications.

2.7 CUTTING AND PATCHING

- A. Core Drilling: The Contractor shall be responsible for core drilling as required for work under this section, but in no case shall the Contractor cut into or weld onto any structural element of the project without the written approval of the Architect.
- B. Cutting and Patching: Cutting, rough patching and finish patching shall be provided as specified in the contract documents. Cutting and patching shall be performed in a neat and workmanlike manner. Upon completion, the patched area shall match adjacent surfaces.
- C. Openings and Sleeves: Locate openings required for work performed under this section. Provide sleeves, guards or other accepted methods to allow passage of items installed under this section.
- D. Roof Penetration: Provide roofer with pitch pans, fittings, etc., required for electrical items which penetrate the roof. Roof penetrations are to be waterproofed in such a manner that roofing guarantees are fully in force. Roof penetrations shall be coordinated with other Trades to ensure that roof warranty is not invalidated.

2.8 SLEEVES AND FORMS FOR OPENINGS

- A. Sleeves: Provide sleeves for Raceways penetrating floors, walls, partitions, etc. Locate necessary slots for electrical work and form before concrete is poured. Watertight sleeves shall be line seal type WS. Fire rated partition sleeves shall be mild steel. Size shall be one standard diameter larger than pipe being installed or of a larger diameter to below 1/4" minimum clearance.
- B. Forms: Provide boxed out forms for Raceway penetrations only where allowed by the Architect. Fill opening after Raceway installation, with equivalent material.

2.9 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. General: Thoroughly instruct the Owner's Representative, to the complete satisfaction of the Engineer, in the proper operation of all systems and equipment provided. The Contractor shall make all arrangements, via the Engineer, as to whom the instructions are to be given in the operation of the systems and the period of time in which they are to be given. The Engineer shall be completely satisfied that the Owner's Representative has been thoroughly and completely instructed in the proper operation of all systems and equipment before final payment is made. If the Engineer determines that complete and thorough instructions have not been given by the Contractor to the Owner's Representative, then the Contractor shall be directed by the Engineer to provide whatever instructions are necessary until the intent of this paragraph of the Specification has been complied with.
- B. Submittals: Submit to the Engineer for approval one (1) electronic copy of instructions for the installation, operation, care and maintenance of equipment and systems, including instructions for the ordering and stocking of spare parts for equipment installed under this contract. The lists shall include part number and suggested suppliers. Each set shall also include an itemized list of component parts that should be kept on hand and where such parts can be purchased.
- C. Information Requirements: Information shall indicate possible problems with equipment and suggested corrective action. The manuals shall be indexed for each type of equipment. Each section shall be clearly divided from the other sections. A sub index for each section shall also be provided.
- D. Instructions: The instructions shall contain information deemed necessary by the Engineer and include but not limited to the following:
 - 1. Introduction:
 - a. Explanation of Manual and its use.
 - b. Summary description of the Electrical Systems.
 - c. Purpose of systems.
 - 2. System:
 - a. Detailed description of all systems.
 - b. Illustrations, schematics, block diagrams, catalog cuts and other exhibits.
 - 3. Operations:

- a. Complete detailed, step by step, sequential description of all phases of operation for all portions of the systems, including start up, shutdown and balancing. Include posted instruction charts.
- 4. Maintenance:
 - a. Parts list and part numbers.
 - b. Maintenance and replacement charts and the Manufacturer's recommendations for preventive maintenance.
 - c. Trouble shooting charts for systems and components.
 - d. Instructions for testing each type of part.
 - e. Recommended list of on-hand spare parts.
 - f. Complete calibration instructions for all parts and entire systems.
 - g. General and miscellaneous maintenance notes.
- 5. Manufacturer's Literature:
 - a. Complete listing for all parts.
 - b. Names, addresses and telephone numbers.
 - c. Care and operation.
 - d. All pertinent brochures, illustrations, drawings, cuts, bulletins, technical data, certified performance charts and other literature with the model actually furnished to be clearly and conspicuously identified.
 - e. Internal wiring diagrams and Engineering data sheets for all items and/or equipment furnished under each Contract.
 - f. Guarantee and warranty data.

2.10 SERVICE AND METERING

- A. Company: The utility company serving this project is FP & L, which will be referred to as the Utility Company herein.
- B. Service: Make arrangements with the Utility Company for obtaining a complete service. Pay charges and provide labor and material for the service. Service shall be obtained at 480Y/277 volts, 3 phase, 4-wire, 60 hertz, volts from the Utility Company. Provide underground cables and raceways for incoming services from the utility's transformer to equipment. Provide Utility Company approved meter socket and empty 1-1/2" Raceway from transformer secondary bushings to meter location.
- C. Fees: Contact the Utility Company to determine if any fees, charges or costs will be due the Company, as required for temporary power, permanent power, installations, hook-ups, etc. This fee, charge or cost shall be included in the bid price.
- D. Payment: Pay for required licenses, fees and inspections. Include costs in the proposed construction cost submission. These costs shall include but not be limited to applicable taxes, permits, necessary notices, certificates and costs required to obtain same.
- E. Codes: Install a complete system in accordance with the latest edition of the National Electrical Code and the latest regulations of governing local, State, County and other applicable codes, including the Utility Company requirements.
- F. Provide transformer pad per Utility Company requirements.

2.11 TEMPORARY LIGHT AND POWER

- A. Lighting: Temporary light shall be based on one 200-watt lamp covering each 1,000 square foot of floor area in the building. Each room 100 square foot and over shall have a minimum of one 100-watt lamp with guards. Provide power for motors up to 3/4 horsepower only. Provisions are to be made for electric welders, if required.
- B. Outlets: Provide outlets located at convenient points so that extension cords of not over fifty (50) feet will reach work requiring artificial light or power.
- C. Other Connections: Contractors of other trades shall furnish their own cords and sockets, as may be required for their work and shall also pay for cost of temporary wiring of construction offices and shanties used by them.

- D. New Fixtures: Permanently installed lighting fixtures may be used for temporary lighting at the Contractor's option with the provision that cool white lamps for fluorescent, clear lamps for incandescent and marked temporary for other types shall be installed. At job completion, lamps shall be replaced with permanent lamps specified.
- E. Wiring: Temporary electrical work shall be furnished and installed in conformity with the National Electrical Code and in accordance with the requirements of the local ordinances and shall be maintained in a workmanlike manner throughout their entire construction period and shall be removed after installation of the permanent electrical systems. Extension cords shall be GFCI protected or shall be fed from GFCI circuit breakers.

PART 3 - EXECUTION

3.1 WORKMANSHIP

- A. General: The installation of materials and equipment shall be performed in a neat, workmanlike and timely manner by an adequate number of craftsmen knowledgeable of the requirements of the Contract Documents. They shall be skilled in the methods and craftsmanship needed to produce a quality level of workmanship. Personnel who install materials and equipment shall be qualified by training and experience to perform their assigned tasks.
- B. Acceptable Workmanship: Acceptable workmanship is characterized by first-quality appearance and function, conforming to applicable standards of building system construction, and exhibiting a high degree of quality and proficiency which is judged by the Architect as equivalent as or better than that ordinarily produced by qualified industry tradesmen.
- C. Performance: Personnel shall not be used in the performance of the installation of material and equipment that, in the opinion of the Engineer, are deemed to be careless or unqualified to perform the assigned tasks. Material and equipment installations not in compliance with the Contract Documents, or installed with substandard workmanship and not acceptable to the Architect, shall be removed and reinstalled by qualified craftsmen, at no change in the contract price.

3.2 PROTECTION AND CLEAN UP

- A. Protection and Restoration: Suitably protect equipment provided under this Division during construction. Restore damaged surfaces and items to "like new" condition before a request for substantial completion inspection.
- B. Handling: Materials shall be properly protected and Raceway openings shall be temporarily closed by the Contractor to prevent obstruction and damage. Post notice prohibiting the use of systems provided under this Contract, prior to completion of work and acceptance of systems by the Owner's representative. The Contractor shall take precautions to protect his materials from damage and theft.
- C. Safeguards: The Contractor shall furnish, place and maintain proper safety guards for the prevention of accidents that might be caused by the workmanship, materials, equipment or systems provided under this contract.
- D. Cleanup: Keep the job site free from debris and rubbish. Remove debris and rubbish from the site and leave premises in clean condition on a daily basis.

3.3 SYSTEMS GUARANTEE

- A. General: Provide a one-year guarantee. This guarantee shall be by the Contractor to the Owner for any defective workmanship or material, which has been provided under this Contract at no cost to the Owner for a period of one year from the date of substantial completion of the System. The guarantee shall include lamps, for ninety days after date of Substantial Completion of the System. Explain the provisions of guarantee to the Owner at the "Demonstration of Completed System".

3.4 FINAL OBSERVATION

- A. General: Work shall be completed, and forms and other information shall be submitted for acceptance one week prior to the request for final observation of the installation.

3.5 SPECIAL CONSIDERATIONS

- A. Comply with special requirements imposed at site by Owner. This may include badging of employees, prohibition of smoking, special working hours, or special working conditions.

END OF SECTION 26 00 10

CERTIFICATE OF COMPLETED DEMONSTRATION MEMO

Note to Contractor: Do not submit this form at the time Technical Information Brochure is submitted. Submit five copies of information listed below for checking at least one week before scheduled completion of the building. After information has been accepted and inserted in each brochure, give the Owner a Demonstration of the Completed Electrical Systems and have the Owner sign five copies of this form. Provide one signed copy for each brochure. After this has been done, a written request for a final inspection of the System shall be made.

Re:

(Name of Project)

(Division Number and Name)

This memo is for the information of all concerned that the Owner has been given a Demonstration of the Completed Electrical Systems on the work covered under this Division. This conference consisted of the system operation, a tour on which all major items of equipment were pointed out, and the following items were given to the Owner;

- (a) Owner's copy of Technical Information Brochure containing approved submittal sheets on all items, including the following; (To be inserted in the Technical Information Brochure after the correct tab).
- (1) Maintenance Information published by manufacturer on equipment items.
 - (2) Printed Warranties by manufacturers on equipment items.
 - (3) Performance verification information as recorded by the Contractor.
 - (4) Check-out Memo on equipment by manufacturer's representative.
 - (5) Written operating instructions on any specialized items.
 - (6) Explanation of the one-year guarantee on the system.
- (b) "As-Built" conditions as described in the record drawing specifications.
- (c) A demonstration of the System in Operation and of the maintenance procedures which shall be required.

(Name of General Contractor)

By:

(Authorized Signature, Title & Date)

(Name of SubContractor)

By:

(Authorized Signature, Title & Date)

Brochure, Instruction, Prints, Demonstration & Instruction in Operation Received:

(Name of Owner)

By:

(Authorized Signature, Title, Date)

cc: Owner, Architect, Engineer, Contractor, Sub Contractor and General Contractor
(List names as stated in cc: above)

SECTION 26 00 80 – TEST AND PERFORMANCE VERIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. General: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work specified in this section.

1.2 DESCRIPTION

- A. Time: Perform verification work as required to show that the System is operating correctly in accordance with contract documents and manufacturer's literature. All verification shall be done after 3-day full operational period.
- B. Submission: Submit check out memos and completed testing results of all systems, cable, equipment, devices, etc., for acceptance prior to being energized or utilized.

1.3 QUALITY ASSURANCE

- A. Compliance: Testing shall comply to the following standards;
 - 1. NEMA
 - 2. ASTM
 - 3. NETA
 - 4. ANSI C2
 - 5. ICEA
 - 6. NFPA

1.4 QUALIFICATIONS OF TESTING FIRM

- A. Qualification: The testing firm shall be an independent testing organization which can function as an unbiased testing authority, professionally independent of the manufacturers, supplier, and installers of equipment or systems evaluated by the testing firm.
- B. Experience: The testing firm shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.
- C. Accreditation: The testing firm shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907, or be a Full Member company of the International Electrical Testing Association.

- D. Certification: The lead, on-site, technical person shall be currently certified by the International Electrical Testing Association (NETA) or National Institute for Certification in Engineering Technologies (NICET) in electrical power distribution system testing.
- E. Personnel: The testing firm shall utilize engineers and technicians who are regularly employed by the firm for testing services.
- F. Proof of Qualifications: The testing firm shall submit proof of the above qualifications when requested.
- G. Companies: NETA certified pre-qualified testing firms for this project are;
 - 1. Electro Test Inc. (941) 693-7100
 - 2. Industrial Electrical Testing, Inc. (904) 396-6501
 - 3. Electric Power Systems (407) 578-6424

PART 2 - TESTS

2.1 EQUIPMENT

- A. Instruments: Supply all instruments required to read and record data. Calibration date shall be submitted on test reports. All instruments shall be certified per NETA standards.
- B. Adjustments: Adjust system to operate at the required performance levels and within all tolerances as required by NETA Standards.

2.2 APPLICATIONS

- A. Switchboards, Panelboards and Mechanical Equipment Feeders: After feeders are in place, but before being connected to devices and equipment, test for shorts, opens, and for intentional and unintentional grounds.
- B. Ratings 600 Volts or Less: Cables 600 volts or less in size #2 AWG and larger shall be meggered using an industry approved "megger" with 500V internal generating voltage. All inspection, cleaning and testing procedures will be in compliance with the recommendations and standards outlined in the "Maintenance Testing Specifications for Electrical Power Distribution", latest edition, published by Internal Electrical Testing Association (NETA). Provide a schedule of testing to the engineer and HCAA construction project manager a minimum of three calendar working days prior to testing. Readings will be recorded in the presence of an owners representative. Readings shall be recorded and submitted to the Engineer for acceptance prior to energizing. Submit one (1) electronic copy of tabulated megger test values for all cables. Insulated resistance test values will be no less than 50 megaohms.
- C. Main circuit breakers and feeder circuit breakers 400 amps and greater shall be tested using primary injection testing as per NETA Specifications. Reports to include manufacturer's time current curve number and trip time. Submit one (1) electronic to the Engineer at substantial completion.

- D. Transformers (75) KVA and larger. Perform Insulation resistance test and turns ratio test. Submit one (1) electronic to Engineer at substantial completion.
- E. Electrode Ground: The resistance of electrodes (main service, generators, transformer, etc.) shall not exceed 5 ohms and shall be measured by The Contractor before equipment is placed in operation. Testing shall be performed on all grounding electrode installations. Testing shall be 2 point method in accordance with IEEE Standard 81. Submit all ground test readings to the Engineer in tabulated format at substantial completion.

2.3 MOTORS

- A. Procedure: Test run each motor, (5 HP) and larger. Tabulate and submit 5 copies of the Test Information at substantial completion for final inspection. Refer to form at the end of this Section.
- B. Provisions: With the system energized, line-to-line voltage and line current measurements shall be made at the motors under full load conditions. The condition shall be corrected when measured values deviate plus or minus 10% from the nameplate ratings.
- C. Insulation: Test the insulation resistance's of all motor windings to ground with an appropriate test instrument as recommended by the motor manufacturer, before applying line voltage to the motors. If these values are less than the manufacturer's recommended values, notify the contractor providing the motor for correction before initial start up.
- D. Power Factor: Check power factor of all motors (5 HP) and larger while driving it's intended load, and at all operating speeds.

2.4 DRY TYPE TRANSFORMERS

- A. Required Factory Tests: Required factory tests shall be as follows;
 - 1. Ratio
 - 2. Polarity
 - 3. Losses
 - a. No load
 - b. Full load
 - 4. Resistance Measurements
 - 5. Impedance
 - 6. Temperature
 - 7. Impulse Strength

- 8. Sound Level
- 9. Exciting Current
- 10. Low-frequency Dielectric Strength
- 11. ANSI Point and Curve

B. Submission: Submit test results with shop drawings.

2.5 EMERGENCY SYSTEM

- A. General: Submit emergency system tests in accordance with NFPA 110. Refer to emergency section of the specification for additional information.

PART 3 - EXECUTION

3.1 SUBMITTALS

- A. Cable Test Report: Submit Cable Test Report in Triplicate.
- B. Transformer Test Report: Indicate comparative data of ANSI and NEMA Standards. Indicate all characteristic values as specified herein. Certified copies of tests on electrically duplicate units are acceptable.
- C. Check Out Memos: Complete all information on forms at the end of this specification, project information, and certificate of completed demonstration memo. Submit data for examination and acceptance prior to final inspection request.
- D. Tabulated Data: Submit data on 8-1/2 x 11 inch sheets with names of the personnel who performed the test.
- E. Final: Submit accepted memos before a request for final inspection.

3.2 QUANTITIES

- A. Quantity: Submit one (1) electronic copy of the check out memo on each major item of equipment. Insert accepted memos in each brochure with the performance verification information and submittal data.

END OF SECTION 26 00 80

PROJECT NAME: _____

MOTOR TEST INFORMATION

Name of Checker: _____

Date Checked: _____

- (a) Name and identifying mark of motor _____
 - (b) Manufacturer _____
 - (c) Model Number _____
 - (d) Serial Number _____
 - (e) RPM _____
 - (f) Frame Size _____
 - (g) Code Letter _____
 - (h) Horsepower _____
 - (i) Nameplate Voltage and Phase _____
 - (j) Nameplate Amps _____
 - (k) Actual Voltage _____
 - (l) Actual Amps _____
 - (m) Starter Manufacturer _____
 - (n) Starter Size _____
 - (o) Heater Size, Catalog No. and Amp Rating _____
 - (p) Manufacturer of dual-element fuse _____
 - (q) Amp rating of fuse _____
 - (r) Power Factor at _____ Speed _____
- (For variable speed motors provide recording chart over operating range)

TABULATED DATA

VOLTAGE AND AMPERAGE READINGS

SWITCHGEAR OR PANELBOARD

FULL LOAD AMPERAGE READINGS:

DATE

TIME

PHASE A.
 B.
 C.
 N.

FULL LOAD VOLTAGE READINGS:

DATE

TIME

PHASE A TO N _____ A TO B
 B TO N _____ A TO C
 C TO N _____ B TO C

NO LOAD VOLTAGE READINGS

DATE

TIME

PHASE A TO N _____ A TO B
 B TO N _____ A TO C
 C TO N _____ B TO C

_____ENGINEERS REPRESENTATIVE

_____CONTRACTORS REPRESENTATIVE

SECTION 26 05 19 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. General: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work specified of this section.

1.2 WIRES AND CABLES

- A. Description: Provide a complete and continuous system of conductors as specified herein. All conductors shall be in accordance with the latest edition of the NEC.

1.3 QUALITY ASSURANCE

- A. Qualifications: Manufacturers shall be regularly engaged in the manufacture of wire systems and fittings of types and sizes required, and whose products have been in satisfactory use in similar service for not less than 5 years in the USA.
- B. Compliance: Materials shall comply with the following codes and standards, as they apply to the different wire types specified herein.

1. UL:

- a. 44 – Rubber insulated wire and cables.
- b. 83 – Thermoplastic-Insulated Wires and Cables
- c. 486A – 80 - Wire Connectors and Soldering Lugs for Use with Copper Conductors
- d. 486B – Splicing Wire Connections
- e. 493 – Thermoplastic-Insulated Underground Feeder and Branch Circuit Cables

2. NFPA:

- a. 70 NEC

3. Insulated Cable Engineers Association (ICEA)

1.4 SUBMITTALS

- A. General: Submit product data on all different types of conductors specified.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Conductors: Branch circuit and feeder conductors for electric power shall be copper type. Utilize THHN/THWN insulation for branch circuits and THWN/THHN insulation for feeders, unless specifically noted otherwise. Conductors #12 AWG and smaller shall be solid #10 AWG and larger shall be stranded. No aluminum wiring shall be permitted. All wire shall be sized as shown on the drawings. If no size is shown, wire shall be #12 AWG, except that branch “homeruns” over 50 ft. in length shall be #10 AWG for 120/208V circuits. Wire in vicinity of heat-producing equipment shall be type XHHW insulation. All wiring shall be manufactured in the USA and of 98 percent resistivity. #14 AWG minimum size conductors shall be used for fire alarm system.
- B. Taps and Splices: All copper taps and splices in #8 AWG or smaller wire shall be fastened together by means of “wirenut” connectors (Ideal or accepted substitution). All taps and splices in wire larger than #8 AWG shall be made with compression type connectors and taped to provide insulation equal to wire.

All taps and splices in manholes or in ground pull box shall be made with compression type connectors and covered with Raychem heavywall cable sleeves (type CTE or WCS) with type "S" sealant cooling. Provide sleeve kits as per manufacturer's installation instructions. All electrical feeders will be run in continuous pieces without joints or splices.

- C. Color Coding, General: All power feeders, grounding conductors and branch circuits #6 AWG and smaller shall be installed with color-coded wire with the same color used for a system throughout the building. Conductors above #6 AWG shall either be fully color-coded or shall have black insulation and be similarly color-coded with tape in all junction boxes and panels in accordance with NEC 310-12. Tape shall cover the conductor insulation within the box or panel in such a manner so as to allow standard markings to be readily observed.
- D. Colors: Unless otherwise accepted, color-code shall be indicated in the Identification section of the specifications. All switchlegs, other voltage system wiring, control and interlock wiring shall be color-coded other than those listed in the Identification Section of these specifications.
- E. Submittals: Submit cut sheet on all major types of wires and cables including splicing tape and terminating/splicing lugs or connectors and cable sleeves.

2.2 MANUFACTURERS

- A. General: Branch circuit and feeder conductors shall be as manufactured by one of the following: General Cable Co., Anaconda, Pirelli, Rome Cable Corporation, , or American Insulated Wire Corporation.

2.3 FIREPROOFING OF CABLES IN MANHOLES

- A. General: All wire and cables in manholes shall be fireproofed. Strips of fireproofing tape approximately 1/16 inch thick by 3 inches wide shall be wrapped tightly around each cable spirally in one-half lapped wrapping, or in two butt-jointed wrappings with the second wrapping covering the joints in the first. The tape shall be applied with the coated side toward the cable, and shall extend one inch into the ducts. To prevent unraveling, the fireproofing (Arc-proofing) tape shall be random wrapped with tape conforming to type FGT of specification MIL-I-15126. The fireproofing (Arc-proofing) tape shall consist of a flexible, conformable fabric having one side coated with a flame-retardant, flexible, polymeric coating and/or a chlorinated elastomer. The tape shall not be less than 0.050 inch thick, and shall weigh not less than 2.5 pounds per square yard. The tape shall be non-corrosive to cable sheath, shall be self-extinguishing and shall not support combustion. The tape shall have a tensile strength of not less than 40 pounds per inch width and when tested under USA Standard L14.184 cut strip method, the tape shall retain 65% of its original tensile strength for the following tests for 168 hours for each requirement;
 - 1. Immersion in distilled water,
 - 2. Immersion of 3% salt water,
 - 3. Exposure to ultra-violet light (30-watt germicidal lamp),
 - 4. Exposure to sunlight (Type S-1 sun lamp) and
 - 5. Exposure to concentrated sewage.
- B. Testing: The completed installation of fireproofing shall be capable of withstanding a 200 ampere arc for 30 seconds and shall be determined by tests made of a sample assembly consisting of a 30 inch diameter lead tube fireproofed (Arc-proofed) as specified above. The lead tube shall have a wall thickness of 1/8 inch. The sample assembly shall be exposed to an arc current from 7/8-inch electrodes located one inch from the assembly at three different points. At each point, the arc current of not less than 195 and not more than 210 amperes at 40 volts D.C. shall be blown magnetically against the assembly until the lead tube melts at the arc contact point. For each of the three tests, the fireproofing (Arc-proofing) shall prevent the arc current from melting the lead tube for at least 25 seconds at any one point and for an average of 30 seconds for the three points.

PART 3 - EXECUTION

3.1 EXECUTION

- A. General: All wiring shall be installed in raceways (power, low voltage and control wiring), unless otherwise indicated or specified under other Sections of this specification. All wiring shall be installed per the latest edition of the NEC.
- B. Connections: Conductors #10 and #12 AWG shall be connected with pre-insulated spring connectors encased in a steel shell and rated at not less than 105 degrees C. A minimum of 3/8-inch skirt shall cover the bare wires. The connector shall meet with UL approval for fixture and pressure work, and shall be "Scotch Lok" Type Y, R and B electrical spring connectors as manufactured by Ideal or approved equal.
- C. Connector Manufacturers: Lugs and wire connectors shall be one of the following: Burndy Corporation, Thomas & Betts, Co., Appleton or ILSCO.
- D. Equipment Installations: Neatly form, train and tie the cables in panelboards, cabinets, wireways, switches and equipment assemblies.

END OF SECTION 260519

SECTION 26 05 26 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. General: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work specified in this section

1.2 GROUNDING ELECTRODES

- A. General: Provide a grounding electrode system, as described in NEC 250, as specified herein and as indicated on plans.
- B. Ground Field / Ground Rods: The ground field shall consist of three 20 ft long vertically driven ground rods arranged in a triangular pattern spaced 20 feet apart. Additional ground rods shall be added as necessary to achieve the desired resistance.
- C. Main Metallic Water Pipe: The building's main metallic underground water piping shall be utilized as a grounding electrode, provided the metal pipe is installed in direct contact with the earth for a minimum of 10 feet. Bond the main metallic water service within 5 ft. of the entrance of the water pipe into the building.
- D. Building Steel: The building steel shall be utilized as a grounding electrode, provided the steel is in direct contact with the earth or is otherwise effectively grounded.
- E. Rebar: In concrete buildings, provide bond to rebar in concrete.
- F. Resistance: Grounding electrode resistance shall not exceed 10 ohms. Overall resistance of the entire grounding electrode system shall not exceed 5 ohms. Provide additional grounding electrodes as required to meet this value. Refer to Section 26 0080 for testing requirements.

1.3 GROUNDING ELECTRODE CONDUCTOR

- A. Grounding Electrode Conductor: A main grounding electrode conductor, bare copper, sized per NEC, shall be run in PVC conduit from main service equipment to the grounding electrodes. This conductor shall also be bonded to the following:
 - 1. Telecommunications service ground within 20' of the electrical service
 - 2. Lightning protection system.
 - 3. Gas and other interior metal piping – refer to NEC.

1.4 SEPARATELY DERIVED GROUNDING SYSTEMS

- A. Description: Provide a separately derived grounding system where indicated herein and as required by the National Electrical Code. Bond neutral and ground busses together.
- B. Services: Provide a separately derived grounding system for all building electrical services and step-down transformers.
- C. Emergency Generator: Provide a separately derived grounding system for the emergency system where 4-pole transfer switches are used (neutral and phase conductors switched).
- D. Multiple Buildings: Multiple buildings fed from the same electrical service shall be provided with separate grounding electrode systems, as required by the NEC and specified herein.

1.5 BONDING AND EQUIPMENT GROUNDING

- A. Description of System: In general, all electrical equipment (metallic conduit, motor frames, panelboards, etc.) shall be bonded together with a green insulated copper system grounding conductor in accordance with specific rules of Article 250 of the NEC Equipment grounding conductors 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.
- B. Equipment Grounding Conductors: All raceways shall have an insulated copper system ground conductor run throughout the entire length of circuit installed within conduit in strict accordance with NEC. Grounding conductor shall be included in total conduit fill when determining conduit sizes, even though not included or shown on drawings.
- C. Redundant Grounding: In general all branch circuits shall be provided with a redundant grounding system through the use of grounding conductors and metallic conduit.
- D. Bonding: In addition to connections to grounding electrodes, the main service ground shall be bonded to the lightning protection system and other underground metal piping.
- E. Light Poles: All exterior light poles shall have their enclosures grounded directly to a separate driven ground at the light pole in addition to the building ground connection, via the circuit equipment ground conductor.
- F. Bushings: Provide insulated grounding bushings on all metallic feeder conduits terminated within panelboards, switchboards or enclosed overcurrent devices. Provide insulated grounding bushings on all branch circuit conduits where concentric knockouts are used.
- G. Connection to Other Systems: Provide all required grounding and bonding connections as specified herein and as required by the National Electrical Code.
- H. Exterior: All exterior grade mounted equipment will have their enclosures grounded directly to a separate driven ground rod at the equipment in addition to the building ground connection.

1.6 SUBMITTALS

- A. General: Submit product data on ground rods, ground wire, ground connectors, ground bars, and data on exothermic welds.
- B. Lugs: Mechanical lugs or wire terminals will be used to ground wires together or to junction boxes and panel cabinets and will be manufactured by Anderson, Buchanan, Thomas and Betts Company, or Burney.

1.7 QUALITY ASSURANCE

- A. Compliance: The entire ground system shall meet or exceed the minimum requirements NEC 250 and IEEE Std. 142 (green book).

PART 2 - PRODUCTS

2.1 GROUNDING ELECTRODE AND BONDING CONDUCTORS

- A. General: Except as specified in C below, provide UL and NEC approved types of copper with THWN, THHN, or XHHW with green insulation or green tape on black insulation the entire length of conductor not in conduit.
- B. Size: Grounding electrode conductors shall be sized as specified herein and on the drawings, but in no case shall be smaller than required by NEC 250.

- C. Insulation: Conductors above ground shall be insulated, conductors run below grade shall be bare.

2.2 GROUNDING ELECTRODES

- A. Ground Rods: Provide copperclad steel, 5/8 inch diameter by 20 feet long vertically driven ground rods. Use of multiple 10 feet sectional ground rods is acceptable.

2.3 CONNECTIONS

- A. Bonding: One piece mechanical lugs or wire terminals, properly sized and approved by the local authority having jurisdiction shall be used to bond ground wires together or to junction boxes and panel cabinets. All contact surfaces will be thoroughly cleaned before connections are made to ensure good metal to metal contact.
- B. Underground: All connections and bonds made underground and to building steel shall be exothermic weld type-connections.

2.4 INSPECTION WELLS

- A. Location: Provide inspection wells for all ground rods covered by concrete, paving, or other permanent materials that prevent access to ground rods.
- B. Description: Inspection well shall be provided with circular, flush traffic rated, grade mounted, twist lock traffic cover with the word "ground" (or similar) on the cover. Inspection test well shall allow clear access to the ground rod and exothermic weld connection of conductor to ground rod. Clearly mark ground rod locations on as-built drawings.

2.5 GROUND BAR

- A. Location: Provide a ground bar connected to the main service ground via a #4/0 grounding conductor in all electrical rooms with step-down transformers and in all communications rooms, or rooms with telephone distribution equipment or network electronics equipment.
- B. Description: Ground bar shall be 12" x 2" x 1/4" (minimum) copper bus mounted to wall 24" AFF via insulated standoffs. All connections to ground bar shall be made via approved mechanical connections.
- C. Interconnection: In addition to the main service ground, all ground bars shall be interconnected to each other via #4/0 insulated grounding conductor. Each ground bar shall also be bonded to local metallic water piping and building steel via #6 insulated grounding conductor.

PART 3 - INSTALLATION

3.1 EXTERIOR

- A. Connection: The main grounding electrode conductor shall be exothermically welded to ground rods and other main system electrodes.

3.2 INTERIOR

- A. Installation: Equipment grounding conductors shall be installed as follows:
 1. Where installed in metal conduit, both conductor and conduit shall be bonded at each end.
 2. Have connections accessible for inspection and made with approved solderless connectors brazed (or bolted) to the equipment or structure to be grounded.
 3. Shall in NO case be a current carrying conductor.
 4. Have green insulation, except that grounding electrode conductors may be bare.

- B. Water Meter: Provide properly sized bonding shunt around water meter and/or dielectric unions in the water pipe.
- C. Cable Tray: Provide a #10 bond from all metallic system conduits to the cable tray.
- D. Bushings: Bond all grounding bushings to the equipment ground bus of the panel or switchboard, or overcurrent device in which it is located. Bond shall be made via an insulated bonding conductor of same size as equipment ground conductor run in the circuit.

3.3 TESTING

- A. Testing: Provide testing as required in other sections of this specification, including but not limited to section 26 0080.
- B. Reports: Submit impedance test reports for all separately derived services to the Engineer prior to project completion.

3.4 CONNECTIONS

- A. Preparation: All contact surfaces shall be thoroughly cleaned before connections are made, to ensure good metal to metal contact.

END OF SECTION 26 05 26

SECTION 26 05 33 – RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. General: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 DESCRIPTION

- A. General: Provide all supports, hangers and inserts required to mount raceways, pullboxes and other equipment provided under this Division.
- B. Support: All items shall be supported from the structural portion of the building. Supports and hangers shall be of a type approved by Underwriters' Laboratories. Wire shall not be used as a support. Boxes and raceways shall not be supported or fastened to ceiling suspension wires or to ceiling channels. Do not install any devices supported by ceiling tiles.
- C. Installation: The Contractor shall lay out and provide his work in advance of the laying of floors or walls, and shall provide all sleeves that may be required for openings through floors, walls, etc. Where plans call for raceway to be run exposed, provide all inserts and clamps for the supporting of conduit.
- D. Systems: Provide raceway system of empty raceways including terminal cabinets, backboards and outlets as described and specified herein.
- E. Conduit: The contractor will prepare and submit coordinated review drawings to HCAA prior to any multiple raceway approved to be run exposed. Refer to section 3.6(A) below. Drawings to include raceway conditions, layout, elevations, coordination with other building system components. All raceways will be installed as close as possible to the structure and at the highest elevation possible.

1.3 QUALITY ASSURANCE

- A. Qualifications: Manufacturers shall be regularly engaged in the manufacture of raceway systems and fittings of types and sizes required, and whose products have been in satisfactory use in similar service for not less than 5 years in the USA.
- B. Aluminum Raceways: Aluminum raceways shall not be used unless specifically called for. Install with aluminum fittings only, when specified.
- C. Compliance: Materials shall comply with the latest edition of the following standards as they apply to the different raceway types specified herein;

1. ANSI:

- a. ANSI C80.1: Rigid Steel Conduit (RSC)
- b. ANSI C80.3: Electrical Metallic Tubing (EMT)

2. UL:

- a. UL 1: Flexible Metal Conduit
- b. UL 6: Rigid Steel Conduit (RSC)
- c. UL 360: Liquid-Tight Flexible Metal Conduit

UL 514: Fittings for Metal Conduit

- d. UL 651: Nonmetallic Conduit (PVC)
- e. UL 797: Electrical Metallic Tubing (EMT)
- f. UL 886: Fittings for Hazardous Locations
- g. UL 1242: Intermediate Metal Conduit (IMC)

3. NEMA:

- a. NEMA TC2: Rigid Nonmetallic Conduit (PVC)
- b. NEMA TC3: Fittings for Rigid Nonmetallic Conduit (RNMC)
- c. NEMA TC8: Utility Duct Type EB-35
- d. NEMA RN1: Plastic Coated Metal Conduit
- e. NEMA VE-1: Ladder Cable Tray
- f. NEMA 8A, 8B, 8C, & 12A: Spine Cable Tray

4. Federal Specifications:

- a. WW-C-581: Rigid Steel Conduit (RSC)
- b. WW-C-563: Electrical Metallic Conduit (EMT)
- c. WW-C-566: Flexible Steel Conduit
- d. WW-C-581E: Intermediate Metallic Conduit (IMC)
- e. WC-1094A: Nonmetallic Rigid Conduit (PVC)
- f. WC-582A Conduit, Raceway, Metal and Fittings; surface

5. ASTM:

- a. ASTM-F-512: Utility duct type EB-35
- b. ASTM-A525 & ASTM-386: Tray manufacturers

1.4 SUBMITTALS

- A. Products: Submit manufacturer's product data, including technical information on each type of raceway system;
- B. Compliance: Product data shall show compliance with this section of the specifications, including U.L. label, manufacturer and manufacturer's written installation instructions.

1.5 RACEWAYS

- A. General: Provide a complete and continuous system of raceways to maintain a protected path for wires and cables to distribute electric power, throughout the project, utilizing U.L. listed, labeled materials, and made in the USA.
- B. Accessories: Provide raceway accessories of types, sizes, and materials, as specified herein complying with manufacturers published product information, which match and mate conduit and tubing.
- C. Interior Minimum Size: Minimum conduit size for all systems (fire alarm, sound, controls, etc) shall be 3/4 inch raceway minimum. All conduits will be UL listed and labeled. The minimum size conduit for power and lighting systems will be 3/4 inch conduit for all circuitry homerun from the panelboard. Conduits branching off of the homerun may be 1/2 inch conduit if it contains no more than 4 conductors (excluding the insulated grounding conductor) and phase conductors no larger than no. 12 AWG.
- D. Site Underground Raceway: Unless otherwise noted, minimum underground raceways shall be 1 inch conduit. Homeruns from the branch circuit overcurrent device, through any control devices to the first exterior junction box or consumption device shall be 1 inch minimum.
- E. System Raceway: Provide end bushings on all conduits.

- F. Pull Strings: Provide pull strings in all empty raceways. Pull strings shall be nylon and shall be impervious to moisture. Pull strings installed in one inch and smaller conduits shall have a tensile strength of not less than 30 lbs. Pull strings installed in conduits larger than 1 inch shall have a tensile strength not less than 200 lbs.

- G. Conduit Bends: The use of NEC Table 344.24 Exception is not allowed.

1.6 LOCATIONS

- A. Materials Above Grade: The following conduit types are to be installed above grade where specifically noted herein;

1. Electrical metallic tubing (thin wall)
2. Intermediate metallic conduit
3. Flexible metal conduit
4. Liquid-tight flexible metal conduit
5. Galvanized rigid steel conduit

- B. Materials Below Grade: The following conduit types are to be installed below grade where specifically noted herein;

1. Rigid galvanized conduit (heavy wall)
2. Heavy wall schedule 40 PVC

- C. Materials on Roofs: The following conduit types are to be installed on roofs where specifically noted herein;

1. Rigid steel conduit (PVC) coated
2. Rigid steel conduit

PART 2 - PRODUCTS

2.1 ELECTRICAL METALLIC TUBING

- A. Fittings: Provide steel compression type fittings. Steel fittings shall be fitted with non-removable insulated throats, and male threaded ends provided with a locknut.
- B. Locknuts: Provide locknuts for securing conduit to enclosures with sharp edges for digging into metal, and ridged outside circumference for proper fastening.

2.2 BUSHINGS

- A. Bushings: Bushings shall be provided on all terminations, mounted on the ends of all EMT connectors 1-1/4 inches and larger and within all equipment.
- B. Construction: Bushings shall have a flared bottom and ribbed sides, with smooth insides to prevent damage to cable insulation.
- C. Insulating Ring: Mold a phenolic insulating ring into sizes 1-1/4 inches and larger.
- D. Grounding: Provide a screw type grounding terminal on all sizes.

2.3 RIGID METAL CONDUIT

- A. Conduit: Conduit ends shall have precision cut hi-torque threads. One end of the conduit shall have a coupling and the other shall be covered with a color-coded plastic thread protector. Conduit shall be manufactured in 10 foot lengths.
- B. Fittings: Fittings shall be cut groove steel. Cast fittings are not acceptable.

2.4 FLEXIBLE STEEL CONDUIT

- A. Conduit and Standards: A continuous length, spirally wound steel strip, zinc-coated, each convolution interlocked with following convolution into a helix form. Product shall meet Federal Specification WW-C-566 and UL 1242.
- B. Fittings: Provide conduit fittings for use with flexible steel conduit of the threadless hinged clamp type, and a male threaded end provided with a locknut.
 - 1. Straight terminal connectors shall be one piece body, female end with clamp and deep slotted machine screw for securing conduit.
 - 2. 45 and 90 degree terminal angle connectors shall be 2 piece body, with removable upper section, female end with clamp and deep slotted machine screw for securing conduit.

2.5 LIQUID-TIGHT FLEXIBLE STEEL CONDUIT

- A. Conduit: Plastic jacketed (PVC) liquid-tight flexible steel conduit with copper bonding conductor, and steel material galvanized inside and outside.
- B. Fittings: Provide cadmium plated, malleable iron fittings with compression type steel ferrule and neoprene gasket sealing rings with insulated throat.

2.6 HEAVY WALL PVC CONDUIT (SCHEDULE 40)

- A. Conduit: Schedule 40, 90 degrees C. UL rated, PVC conduit shall be composed of High Impact PVC (polyvinyl chloride C-2000 Compound), and shall conform to industry standards, and be UL listed in accordance with Article 347 of National Electrical Code for underground and exposed use. Materials must have tensile strength of 55 PSI, at 70 degrees F., flexural strength of 11,000 psi, compression strength of 8600 psi. Manufacturer shall have five years extruding PVC experience.

2.7 INTERMEDIATE METAL CONDUIT

- A. Type: Intermediate metal conduit (IMC) shall be high frequency electro-welded into tube form to produce a high ductile conduit that can be easily bent with standard tools approved for IMC.
- B. General: Conduit ends shall have precision cut hi-torque threads. One end of the conduit shall have a coupling and the other shall be covered with a color-coded plastic thread protector. Conduit shall be manufactured in 10 foot lengths.
- C. Finish: The electro-galvanized zinc finish shall be corrosion resistant and shall not crack or flake. A chromate conversion coating shall be applied over the entire tube as an additional corrosive preventative. The interior shall be protected and lubricated with a special silicone hard finish enamel.

2.8 MALLEABLE IRON EXPANSION FITTINGS

- A. Type: Conduit expansion fittings shall be malleable iron (hot dipped galvanized inside and outside).
- B. Fittings: These fittings shall have a 4 inch expansion chamber to allow approximately 2 inch movement parallel to conduit run in either direction from normal.
- C. Internal Bonding: Fittings shall have factory-installed packing and internal tinned copper braid packing to serve as a bonding jumper.

- D. External Bonding: Unless the fitting used is listed by Underwriters Laboratories for use "without external bonding jumpers", an external copper bonding jumper shall be installed with each metal expansion fitting. One end of the fitting shall be clamped on each conduit entering fitting.

2.9 SUPPORTING DEVICES

- A. Hangers: Hangers shall be made of durable materials suitable for the application involved. Where excessive corrosive conditions are encountered, hanger assemblies shall be protected after fabrication by galvanizing, or approved suitable preservative methods.
- B. Materials: Insert anchors shall be installed on concrete or brick construction, with hex head machine screws. Recessed head screws shall be used in wood construction. An electric or hand drill shall be used for drilling holes for all inserts in concrete or similar construction. Installed inserts, brick, shall be near center of brick, not near edge or in joint. Drilled and tapped, and round head machine screws shall be used where steel members occur. All screws, bolts, washers, etc., used for supporting raceways or outlets shall be fabricated from rust-resisting metal, or accepted substitution. Gunpowder set anchors are not permitted.
- C. Exterior: Supporting devices for exterior use shall be 316 stainless steel unless otherwise noted on drawings.
- D. PVC Coated Conduit: Supporting devices for PVC coated conduit shall be as manufactured by the PVC coated conduit manufacturer and shall match in color and appearance.

2.10 TELEPHONE TERMINAL BOARDS

- A. Terminal Boards: Telephone Boards shall be 8 foot high and of the width shown unless otherwise noted. Terminal boards shall be 3/4 inch A/C grade exterior plywood painted light gray with fire resistant paint.
- B. Grounding: Each terminal board shall be provided with a #3/0 AWG bare copper conductor installed in 3/4 inch PVC conduit to the building service ground. Service ground attachment shall be made with an approved lug. Provide 6 foot excess ground conductor length at terminal board for connection to equipment.

2.11 MANHOLES

- A. Concrete strength: The design of concrete mixture shall be responsibility of the contractor as set forth under ASTM Standard C-94 for ready-mixed concrete. The concrete produced shall have a concrete strength at 28 days that shall be not less than 2500 PSI.
- B. Concrete slump: The slump when tested in accordance with ASTM Standard C-143, shall not be more than 3 inches for vibrated concrete and 4 inches for non-vibrated concrete. Ready –mixed concrete shall be mixed and delivered to the project in accordance with ASTM Standard C-94, using Alternative No. 2 for the mix design. With each load of concrete delivered, the producer shall provide in duplicate before unloading at the site, delivery tickets of certification as required by ASTM C-94.
- C. Mixing Option: At contractor's option, concrete may be mixed by volume at the project site in an accepted type batch mixer in the manner specified for stationary mixers in ASTM Standard C-94. The portions of cement, aggregate and water shall be selected to provide the characteristics indicated below for the compressive strength specified. Conformance with the strength requirements shall be as determined in accordance with ASTM Standard C-39.
- D. Precast Option: Manholes may be of the precast type if accepted, submit drawings, calculations, and necessary detail to determine acceptability.
- E. Brick: Brick used where indicated shall be sewer and manhole brick conforming to ASM C-32, Grade MS.

- F. Mixture: Mortar shall be mixed in proportions of 1-part Portland Cement, $\frac{1}{4}$ part hydrated lime and between 2 $\frac{1}{4}$ and 3 parts and by volume. (At contractor's option, mortar may be mixed in the proportions of 1 part Portland Cement and between 4 $\frac{1}{2}$ and 6 parts of sand by volume.)
- G. Structural: Reinforcing bars shall be deformed and comply with either of the following ASTM Standards: Billet Steel Bars A-615 or Rail Steel Bars A-616.
- H. Forming: Material for concrete forms shall be smooth boards exterior grade plywood or metal.
- I. Drainage: Drainage Pipe and Fittings shall be cast-iron, extra strength. Drains shall be plain pattern in accordance with Specification W M-P-541.
- J. Covers: Metal Frames, Covers, and Gratings, except as indicated or specified otherwise shall conform to Specification RR-F-621 and shall be of cast iron. Frames and covers of steel shall be welded by qualified welders in accordance with standard commercial practice. Steel covers shall be rolled steel floor plate having an accepted anti-slip surface. Steel gratings shall be welded construction and conform to the applicable requirements of Specification RR-G-66, Type 1.
- K. Accessories: Pulling-in irons shall be steel bars bent in the form indicated, and case in the walls and floors. In the floor, they shall be centered above or below, and opposite the conduits entering the manhole. Pulling-in irons shall be projected into the manhole approximately 4 inches. Irons shall be zinc-coated after fabrications in accordance with
- L. Specifications MiL-Z-17871. Cable Racks, including hooks and insulators, shall be installed in manhole and shall be sufficient to accommodate the present and future cables and shall be spaced not more than 18 inches apart horizontally. The wall bracket shall be Channel or T-Section steel. The hooks shall be of steel or malleable iron and shall be of the removable type. Insulators shall be dry-process glazed porcelain. The metal portion of racks shall be zinc-coated after fabrication in accordance with Specification MIL-Z-17871.

PART 3 - EXECUTION

3.1 CONDUITS

- A. Unless noted otherwise, provide as a minimum 1 inch raceway from each of the following device locations to cable tray, j-hooks, or corridor ceiling cavity when cable tray. Provide insulated bushings at ends of all raceways.
 - 1. Telephone
 - 2. Cable TV
 - 3. Call Box
 - 4. CCTV
 - 5. DDC
 - 6. Data
 - 7. Elevator Location Panel
 - 8. Security
- B. All fire alarm wiring shall be run in conduit.
- C. Provide plenum-rated cable for all systems conductors.
- D. All wiring above non-accessible ceilings shall be installed in raceways.

3.2 TELEPHONE COMPANY COORDINATION

- A. Telephone Company: The Contractor shall notify the Telephone Company when the conduit system is being installed. The Contractor shall coordinate the work with the Telephone Company as required.

3.3 CABLE TV COMPANY COORDINATION

- A. Cable Television Company: The Contractor shall notify the Cable Television Company when the conduit system is being installed. The Contractor shall coordinate the work with the Cable Television Company as required.

3.4 IDENTIFICATION OF BOXES

- A. Tags: During installation of pull strings all pull strings shall be marked with vinyl tags indicating where the opposite end may be found.

3.5 BLANK PLATES

- A. Plates: Unless otherwise noted all outlet boxes shall receive blank plates matching the finish of plates on electrical devices in the same room.

3.6 RACEWAY INSTALLATION

- A. Support: All raceways shall be run in a neat and workmanlike manner and shall be properly supported and in accordance with the latest edition of the NEC. Supporting conduit and boxes with wire is not acceptable. Any exposed conduit viewable by the public must be approved by an owner's representative prior to installation. Exposed raceways, where allowed, shall be supported with clamp fasteners with toggle bolt on hollow walls, and with lead expansion shields on masonry. All conduits shall be securely fastened in place with at least one support per eight foot section. Support within one foot of changes in direction. All required hangers, supports and fastenings shall be provided at each elbow and at no more than one foot from the end of each straight run terminating at a box or cabinet. The use of perforated iron for supporting conduits shall 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 accepted devices with suitable bolts, expansion shields (where needed) or beam-clamps for mounting to building structure or special brackets. Multiple runs of raceways will be routed together. Raceways will not be located within six inches of other system components (HVAC ducts, chilled water lines, sprinkler pipes, domestic water lines, etc)
- B. Hanger Installation: Where 2 or more raceways 1 inch or larger run parallel trapeze hangers may be used consisting of concrete inserts, threaded solid rods, washers, nuts and galvanized "L" angle iron, or Unistrut cross members. These raceways shall be individually fastened to the cross member of every other trapeze hanger with galvanized cast one hole straps, clamp backs, bolted with proper size cadmium machine bolts, washers and nuts. If adjustable trapeze hangers are used to support groups of parallel conduits, U-bolt type clamps shall be used at the end of a raceway run and at each elbow. J-bolts, or approved clamps, shall be installed on each third intermediate trapeze hanger to fasten each raceway.
- C. Sealant: Provide a closed cell silicone foam sealant rated to provide a rating equal to the wall, ceiling, or floor assembly rating. Provide seals for the exterior of conduit penetrations consisting of a cast-in-place sleeve with a compressible rubber gasket between the conduit and the sleeve. Provide seals for the interior of the conduit penetrations consisting of gland type sealing bushing or closed cell silicone foam. Provide duct seal inside an appropriate seal-off fitting to seal the interior of the conduit system from water seepage or hazardous gases.
- D. Routing: Raceways shall be run parallel to building walls wherever possible, exposed or concealed as specified, and shall be grouped in workmanlike fashion. Crisscrossing of conduits shall be minimized.
- E. Location: All raceways except those from surface-mounted switches, outlet boxes or panels shall be run concealed from view. Surface mounted devices and equipment shall be specifically noted on the contract drawings. It is the intent that all raceways shall be run concealed unless specifically noted.

- F. Protection: All raceway runs, whether terminated in boxes or not, shall be capped during the course of construction until wires are pulled in and covers are in place. No conductors shall be pulled into raceways until the raceway system is complete.
- G. Coordination: All raceways shall be kept clear of mechanical equipment and plumbing fixtures to facilitate future repair or replacement of said fixtures without disturbing wiring. Except where it is necessary for control purposes, all raceways shall be kept away from items producing heat.
- H. Masonry Installation: 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.
- I. Arrangement: All raceways shall be run connecting outlet to circuits generally as shown on the drawings. Provide circuit connection arrangement shown. Actual final arrangement shall be in accordance with the record drawings section as specified herein.
- J. Grounding: All branch circuit and feeder raceways shall have a copper system ground conductor within the conduit throughout the entire length of the circuit. All conduits shall be electrically continuous to establish redundant grounding.
 - 1. Branch circuit raceways shall have an insulated equipment grounding conductor installed within the conduit raceway system.
 - 2. Grounding conductor shall be included in total conduit fill determining conduit sizes, even though not shown on drawings.
 - 3. Grounding conductors run with feeders may be bare.
- K. Empty Raceways: Raceways which do not have conductors provided under this Division of the specifications shall be left with an acceptable nylon pullcord in raceway.
- L. Manufacturer: Rigid Metallic Conduit, Electrical Metallic Tubing, Flexible Steel Conduit, Liquid-Tight Flexible Conduit, and PVC Conduit shall be manufactured within the United States, and each shall be as manufactured by one manufacturer.
- M. Roof Installation: Raceway installations on roofs shall be kept to a bare minimum. Raceway shall be supported above roof at least 6 inches using approved raceway supporting devices. Supports shall be fastened to roof using roofing adhesive as specified in other sections of this specification.
- N. Firewall Installation: Provide pullboxes, junction boxes, fire barrier at fire rated walls etc., as required by NEC Article 300 where required.
- O. Dissimilar Metals: Avoid the use of dissimilar metals to reduce the possibility of electrolysis. Where dissimilar metals are in contact, coat all surfaces with corrosion inhibiting compound before assembling.
- P. Sealoff Fittings: Provide raceway sealoffs wherever the raceway system enters a hazardous or wet area or areas of drastic temperature change such as coolers, freezers, etc. as required.
- Q. Identification: Provide appropriate identification as required by codes and as indicated on the drawings and in accordance with the methods specified herein.
- R. Anchors: Raceways shall be anchored down to prevent floating while pouring in concrete.

3.7 SITE UNDERGROUND CONDUIT INSTALLATION

- A. General: All underground raceways (with exception of raceways installed under floor slab) shall be installed in accordance with Section 300-5 of the NEC except that the minimum cover for any raceway or duct bank shall be two feet, unless otherwise indicated.
- B. Stubs: Spare raceway stubs shall be capped and accurately dimensioned on as-built drawings.

- C. Separation: All raceways run underground, or stubbed above floor shall be separated with plastic interlocking spacers manufactured specifically for this purpose, or shall be strapped to Kindorf channel supported by raceway driven into ground or tied to steel.
- D. Coating: Rigid metallic conduit installed underground shall be coated with waterproofing black mastic before installation, and all joints shall be recoated after installation.

3.8 RIGID METALLIC CONDUIT

- A. Locknuts: Rigid steel box connections shall be made with double locknuts and bushings. Turn down on threads to solidly connect raceway to box or enclosure.
- B. Bushings: Grounded insulated bushings shall be used on all rigid steel conduits terminating in panels, wire gutters, or cabinets. Bushing 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.

3.9 PVC RACEWAYS

- A. Floor Penetrations Exposed: Where PVC penetrates a floor in an exposed location from underground or in slab, a black mastic coated steel conduit elbow shall be used.
- B. Location: No PVC shall be allowed anywhere except underground or in slab.
- C. Ground Conductor Installation: All individual bare copper ground conductors (i.e. service, transformer, or lightning protection grounds) shall be installed in PVC raceway.
- D. Joints: PVC joints shall be solvent welded. Threads shall not be permitted on PVC raceway and fittings, except for rigid steel to PVC couplings. Installation of PVC raceway shall be in accordance with manufacturer's recommendations.
- E. Restrict Support: PVC raceway shall not be used to support fixture or equipment.
- F. Bends: Field bends shall be made with an approved hotbox. Heating with flame and hand held dryers are prohibited.

3.10 FLEXIBLE CONNECTIONS

- A. Vibrating Equipment Connection: All connections to motors or other vibrating equipment (except dry type transformers) or at other locations where required shall be made with not less than 12 inches of flexible liquid-tight steel conduit, using special type of connectors with strain relief fittings at both terminations of conduit, Kellems Type 074-09 Series or accepted substitution.
- B. Normal Type: Flex connectors shall have insulated throat and shall be T & B 3100 Series or accepted substitution.
- C. Angle Type: Use angle connectors wherever necessary to relieve angle strain on flex conduit.
- D. Transformer Connection: Connections to dry type transformers shall be made with flexible conduit.

3.11 EXPANSION FITTINGS

- A. Installation: Provide expansion fittings in each conduit run wherever it crosses an expansion joint. Install the fitting on one side of the joint with its sliding sleeve end flush with joint, and with a length of bonding jumper in expansion equal to at least three times the normal width of joints.

- B. Location: Provide expansion fittings in each conduit run which is mechanically attached to separate structures to relieve strain caused by shift on one structure in relation to the other.

3.12 ELECTRICAL METALLIC TUBING

- A. Location: Install Electrical Metallic Tubing (thin wall) inside buildings, above the ground floor where not subject to mechanical injury.
- B. Handling: All cut ends shall be reamed to remove rough edges.

END OF SECTION 26 05 33

SECTION 26 05 53 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. General: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work specified of this section.

1.2 DESCRIPTION

- A. Extent: Electrical identification work as required by the Contract Documents or other specifications.
- B. Types: Electrical identification work specified in the Contract Documents include the following;
 - 1. Electrical power, control and communication conductors.
 - 2. Operational instructions and warnings.
 - 3. Danger signs.
 - 4. Conduits, boxes, etc.
 - 5. Distribution Equipment.
 - 6. Cabinets.
 - 7. Equipment/system identification signs and tags.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacturer of electrical identification products of types required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. NEC Compliance: Comply with NEC as applicable to installation of identifying labels and markers for wiring and equipment.
- C. UL Compliance: Comply with applicable requirements of UL Standard 969, "Marking and Labeling Systems", pertaining to electrical identification systems.
- D. ANSI Compliance: Comply with applicable requirements of ANSI Standard A13.1, "Scheme for the Identification of Piping Systems", and ANSI Standard Z53.1 "Color Designation."
- E. NEMA Compliance: Comply with applicable requirements of NEMA Standard No's. WC-1 and WC-2 pertaining to identification of power and control conductors.
- F. ADA Compliance: All signage shall meet ADA standards. Identification for maintenance purposes shall be as specified herein.
- G. Facility Compliance: All identification methods currently utilized by the owner's standards shall be strictly adhered to, and shall take precedence over the identification requirements listed.

1.4 SUBMITTALS

- A. General: Submit shop drawings of all identification materials to be used for this project. Submit one sample of each item with the shop drawings.

PART 2 - PRODUCTS

2.1 ACCEPTABLE SUPPLIERS OR MANUFACTURERS

- A. General: Subject to compliance with requirements, manufacturers offering electrical identification products which may be incorporated in the work include, but not limited to, the following:

1. Alarm Supply Co, Inc.
2. Direct Safety Co.
3. Ideal Industries, Inc.
4. LEM Products, Inc.
5. Markal Company
6. National Band and Tag Co.
7. Panduit Corp.
8. Seton Name Plate Co.
9. Thomas and Betts Co.
10. Carlton Industries, Inc.

2.2 LANGUAGE

- A. General: Provide all products in this section in English.

2.3 ELECTRICAL IDENTIFICATION MATERIALS

- A. General: Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than one single type is specified for an application, selection shall be at the installer's option, however, provide a single selection for each application.
- B. Conduit System Markers: Provide manufacturer's standard pre-printed, flexible, permanent, conduit markers, extending 360 degrees around conduits. Markers shall be designed for attachment to conduit by adhesive, adhesive lap joint, matching adhesive plastic tape at each end of marker, or pretensioned snap-on. Color shall match system printing requirements.
- C. Voltage Marking: Except as otherwise indicated, provide lettering which indicates voltage of the conductor(s) in conduit. Provide 4 inch minimum length with 7/8 inch minimum lettering for 2 inch and smaller conduit. Provide 8 inch minimum length with 1-1/4 inch minimum lettering for larger than 2 inch conduit. Provide one marker for each 50' section of conduit. Color shall match system printing requirements.
- D. Cable/Conductor Identification Bands: Provide manufacturer's standard vinyl cloth self-adhesive cable/conductor markers of the wrap-around type; either pre-numbered plastic coated type, or write-on type with clear plastic or white self-adhesive cover flap; numbered to show circuit identification.
- E. Plasticized Tags: Manufacturer's standard preprinted or partially preprinted accident prevention and operation tags, of plasticized card stock with matt finish suitable for writing, approximately 3-1/4 x 5-5/8 inch, with brass grommets and wire fasteners, and with appropriate pre-printed wording including large size primary wording, e.g., DANGER, CAUTION, DO NOT OPERATE.
- F. Baked Enamel Danger Signs: Provide manufacturer's standard "DANGER" signs of baked enamel finish on 20 gauge steel; of standard red, black and white graphics; 14 x 10 inch size except where 10 x 7 inch is the largest size which can be applied where needed, and except where larger size is needed for adequate vision; with recognized standard explanation wording, and subsequent directive e.g. HIGH VOLTAGE, KEEP OUT; BURIED CABLE, DO NOT DIG; LIVE PARTS, DO NOT TOUCH SWITCH.

- G. Engraved Plastic Laminate Nameplates: Provide engraving phenolic plastic laminate, in sizes and thicknesses indicated, engraved with 1/16 inch thick lines with square standard pica lettering and wording as specified herein, black face and white core plies (letter color) for normal systems, kelly green and white for equipment, bright orange and white for critical, bright yellow and black for life safety, and red and white for fire alarm and where noted in the specifications. Punch for mechanical fastening, except where adhesive mounting is necessary because of substrate. Material thickness shall be 1/16 inch. Provide beveled edge in order to eliminate sharp corners. Provide self-tapping stainless steel round head screws. Provide contact type permanent adhesive where screws cannot or shall not penetrate the substrate. Adhesive nameplate shall be permanently installed. Titles shall be 1/2 inch high and all other lettering shall be 1/4 inch high.
- H. Underground Type Plastic Line Marker: Manufacturer's standard permanent, bright colored, continuous printed, metal backed plastic tape, intended for direct burial service; not less than 6 inches wide x 4 mils thick. Provide tape with printing which most accurately indicates the type of service or type of buried cable.
- I. Junction Box Identification: Provide neat indelible felt tip, stenciled marking on junction box and pullbox covers indicating panel and circuit numbers contained in the box. Letter sizes shall be 1 inch high minimum. Provide non-stenciled markings inside the junction box and on the exterior edge to match the cover markings.

2.4 LETTERING AND GRAPHICS

- A. General: Coordinate names, abbreviations, and other designations used in electrical identification work, with corresponding designations specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by the manufacturer and as required for proper identification and operation/maintenance of the electrical system equipment. Comply with ANSI A13.1 pertaining to minimum sizes for letters and numbers.
- B. Size: System identification labeling consists of providing minimum 1/2 inch high stenciled black letters for raceway systems.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION

- A. Installation: Install electrical identification products as indicated, in accordance with manufacturer's written instructions, as required by the NEC and as specified herein.
- B. Coordination: Where identification is to be applied to surfaces which require a field finish application, install identification after completion of such application.
- C. Regulations: Comply with governing regulations and requests of governing authorities for the identification of electrical work.
- D. Hazards: Identify all rooms, spaces, and equipment that house potential electrical hazards, and label with appropriate signage or indicators.

3.2 RACEWAY SYSTEM IDENTIFICATION

- A. Color Coding: All electrical conduits shall be identified by color-coding. Apply color-coded identification on electrical conduit in a neat and workmanlike manner. Utilize a stencil for application of paint.
- B. Identification: Identify all raceways provided or utilized as part of this project as follows;

1. Apply bands 10 feet on center along the raceway system and at each side of walls or floors, and at branches from mains.
2. Identify the following services:

	<u>Service</u>	<u>Label</u>
a.	Low Voltage	120/208 Voltage
b.	High Voltage	277/480 Voltage
c.	Fire Alarm	Fire Alarm
d.	Telephone	Telephone
e.	Computer	Computer
f.	Telephone/computer	Telephone/computer
g.	Emergency	Emergency
	(1) Life Safety	Life Safety
	(2) Equipment Branch	Equipment Branch

3. Spot Painting on Rough-in:

- a. Conduit, raceways, boxes, backboxes, panelboards, etc. shall be spot painted. Conduit shall be identified within 6 inches of the box or enclosure. The entire box and coverplate shall be painted.
- b. Use following colors for color bands and for color coding:

	<u>System</u>	<u>Color</u>
(1)	Life Safety	Bright Yellow
(2)	Non-Essential Emergency	Kelly Green
(3)	Essential Distribution (from Generator to Generator Distribution Panel)	Purple
(4)	Normal Power	Silver
(5)	Miscellaneous Communications	Brown
(6)	Fire Alarm	Red
(7)	Telephone\Computer	Black
(8)	TV	Light Pink

CABLE/CONDUCTOR IDENTIFICATION

- C. General: Apply cable/conductor identification, including voltage, phase and feeder number, on each cable/conductor in each box/enclosure/cabinet where conductors of more than one circuit or communication (such as color coded conductors) is provided. Match identification with marking system used in panelboards, shop drawings, contract documents, and similar previously established identification for the project's electrical work.
- D. Color Coding: Color code all power and lighting cable. Use wire colored by integral pigmentation, making the wire 100 percent colored. Where not practicable or available (in larger conductor sizes), color code the wire by using colored plastic tape, painting the ends accessible at junction or pull boxes, or other method acceptable to the Engineer. Use the following chart as applicable;

<u>CONDUCTOR</u>	120/208 <u>VOLTS</u>
Phase A	Black
Phase B	Red
Phase C	Blue
Neutral	White
Equip.Ground	Green

<u>CONDUCTOR</u>	277/480 <u>VOLTS</u>
Phase A	Brown
Phase B	Orange
Phase C	Yellow

Neutral Gray
Equip.Ground Green

3.3 OPERATIONAL IDENTIFICATION AND WARNINGS

- A. General: Provide identification and warning wherever reasonably required to ensure safe and efficient operation and maintenance of the electrical systems. Provide identification and warning identification if necessary for signage to help prevent misuse of electrical facilities by unauthorized personnel.
- B. Plasticized signs: Install self-adhesive plastic signs or similar equivalent identification, instruction or warnings on switches, outlets and other controls, devices and covers of electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for the intended purposes.
- C. Locations: In addition to installation of danger signs required by governing regulations and authorities, install appropriate danger signs at locations indicated and at locations subsequently identified as constituting dangers for persons in or about the project.
- D. High Voltage: Install danger signs wherever it is practicable, for persons to come into contact with electrical power of voltages higher than 277 volts to ground.
- E. Equipment Identification:
 - 1. Nameplates: Install an engraved phenolic plastic laminate nameplate on each unit of electrical equipment in the building, including central or master unit of each electrical system unless unit is specified with its own self-explanatory identification or signal system. Except as otherwise indicated, provide single line of text. Provide text matching terminology and numbering of the contract documents and shop drawings.
 - a. Normal system shall be 1/2 inch high white lettering in a black field.
 - b. Emergency system shall be 1/2 inch high white lettering in a yellow field for life safety, orange for critical and green for equipment branch.
 - 2. Locations: Provide nameplates for each unit of the following categories of electrical work: Switchboard, panelboards, electrical cabinets, and enclosures.
 - 3. Provide a nameplate outside above the door (if equipped with one) listing its designation, voltage, source and circuit number.
 - a. Access panel/doors to electrical facilities.
 - b. Major electrical switchgear and switchboards.
 - c. Power Transfer Equipment.
 - d. Transformers.
 - e. Motor starters.
 - f. Disconnect switches.
 - g. Enclosed circuit breakers.
 - h. Communication Control Panels, Terminal Cabinets and Equipment Cabinets.
 - i. Remote Annunciators
 - j. Terminal Boards
 - k. Security CCTV Cameras
 - l. Other similar equipment as designated by the Engineer.
 - 4. Viewing: Install nameplates at locations indicated and where not otherwise indicated at a location for the best convenience of viewing without interference with operation and maintenance of equipment.

- a. Secure to substrate with rigid fasteners. Utilize adhesive where fasteners cannot penetrate substrate.
- 5. Names: The names or wording used for a particular machine shall be the same as the one used on all motor starters, disconnects and remote button stations nameplates for that machine.

END OF SECTION 26 05 53

SECTION 26 05 73.16 - COORDINATION STUDIES

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 computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.
 - 1. Study results shall be used to determine coordination of series-rated devices.

1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.
- B. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.
- C. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- D. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- E. Power System Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- F. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.
- G. SCCR: Short-circuit current rating.
- H. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- I. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS

- A. Product Data:
 - 1. For computer software program to be used for studies.
 - 2. Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.

- a. Coordination-study input data, including completed computer program input data sheets.
 - b. Study and equipment evaluation reports.
- 3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.
 - a. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
 - 1. For Power System Analysis Software Developer.
 - 2. For Power Systems Analysis Specialist.
 - 3. For Field Adjusting Agency.
- B. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For overcurrent protective devices to include in emergency, operation, and maintenance manuals.
 - 1. The following are from the Coordination Study Report:
 - a. Final one-line diagram.
 - b. Final protective device coordination study.
 - c. Coordination study data files.
 - d. List of all protective device settings.
 - e. Time-current coordination curves.
 - f. Power system data.

1.7 QUALITY ASSURANCE

- A. Studies shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.
- D. Power System Analysis Software Qualifications:
 - 1. Computer program shall be designed to perform coordination studies or have a function, component, or add-on module designed to perform coordination studies.
 - 2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
- E. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

F. Field Adjusting Agency Qualifications:

1. Employer of a NETA ETT-Certified Technician Level III responsible for all field adjusting of the Work.
2. A member company of NETA.
3. Acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

- A. Comply with IEEE 242 and IEEE 399.
- B. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
 1. Optional Features:
 - a. Arcing faults.
 - b. Simultaneous faults.
 - c. Explicit negative sequence.
 - d. Mutual coupling in zero sequence.

2.2 COORDINATION STUDY REPORT CONTENTS

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram of modeled power system, showing the following:
 1. Protective device designations and ampere ratings.
 2. Conductor types, sizes, and lengths.
 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 4. Motor and generator designations and kVA ratings.
 5. Switchgear, switchboard, motor-control center, and panelboard designations.
 6. Any revisions to electrical equipment required by the study.
 7. Study Input Data: As described in "Power System Data" Article.
 - a. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
- D. Protective Device Coordination Study:
 1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.
 - a. Phase and Ground Relays:

- 1) Device tag.
 - 2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
 - 3) Recommendations on improved relaying systems, if applicable.
- b. Circuit Breakers:
- 1) Adjustable pickups and time delays (long time, short time, and ground).
 - 2) Adjustable time-current characteristic.
 - 3) Adjustable instantaneous pickup.
 - 4) Recommendations on improved trip systems, if applicable.
- c. Fuses: Show current rating, voltage, and class.
- E. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
 2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
 3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
 4. Plot the following listed characteristic curves, as applicable:
 - a. Power utility's overcurrent protective device.
 - b. Medium-voltage equipment overcurrent relays.
 - c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
 - d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
 - e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
 - f. Cables and conductors damage curves.
 - g. Ground-fault protective devices.
 - h. Motor-starting characteristics and motor damage points.
 - i. Generator short-circuit decrement curve and generator damage point.
 - j. The largest feeder circuit breaker in each motor-control center and panelboard.
 5. Maintain selectivity for tripping currents caused by overloads.
 6. Maintain maximum achievable selectivity for tripping currents caused by overloads on series-rated devices.
 7. Provide adequate time margins between device characteristics such that selective operation is achieved.
 8. Comments and recommendations for system improvements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance of the Work. Devices to be coordinated are indicated on Drawings.

1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

A. Obtain all data necessary for conduct of the overcurrent protective device study.

1. Verify completeness of data supplied in one-line diagram on Drawings. Call any discrepancies to Architect's attention.
2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
3. For [equipment that] [relocated equipment and that which] is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. Qualifications of technicians and engineers shall be as defined by NFPA 70E.

B. Gather and tabulate all required input data to support the coordination study. List below is a guide. Comply with recommendations in IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification. Data include, but are not limited to, the following:

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Electrical power utility impedance at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus (three phase and line to ground).
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Maximum demands from service meters.
13. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
14. Motor horsepower and NEMA MG 1 code letter designation.
15. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
16. Medium-voltage cable sizes, lengths, conductor material, cable construction, metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).
17. Data sheets to supplement electrical distribution system one-line diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.

- c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
- d. Generator thermal-damage curve.
- e. Ratings, types, and settings of utility company's overcurrent protective devices.
- f. Special overcurrent protective device settings or types stipulated by utility company.
- g. Time-current-characteristic curves of devices indicated to be coordinated.
- h. Manufacturer, frame size, interrupting rating in amperes root mean square (rms) symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
- i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
- j. Switchgear, switchboards, motor-control centers, and panelboards ampacity, and SCCR in amperes rms symmetrical.
- k. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

3.3 COORDINATION STUDY

- A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.
- B. Comply with IEEE 399 for general study procedures.
- C. Base study on device characteristics supplied by device manufacturer.
- D. Extent of electrical power system to be studied is indicated on Drawings.
- E. Begin analysis at the service, extending down to system overcurrent protective devices as follows:
 - 1. To normal system low-voltage load buses where fault current is 10 kA or less.
 - 2. Include equipment rated 240 V ac or less when supplied by a single transformer rated less than 125 kVA.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. Transformer Primary Overcurrent Protective Devices:
 - 1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
 - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
 - 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.
- H. Motor Protection:
 - 1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
 - 2. Select protection for motors served at voltages more than 600 V according to IEEE 620.
- I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands

the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

- J. Generator Protection: Select protection according to manufacturer's written instructions and to IEEE 242.
- K. Include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for fault-current dc decrement, to address asymmetrical requirements of interrupting equipment.
- L. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram.
 - 1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- M. Protective Device Evaluation:
 - 1. Evaluate equipment and protective devices and compare to short-circuit ratings.
 - 2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
 - 3. Any application of series-rated devices shall be recertified, complying with requirements in NFPA 70.
 - 4. Include in the report identification of any protective device applied outside its capacity.

3.4 LOAD-FLOW AND VOLTAGE-DROP STUDY

- A. Perform a load-flow and voltage-drop study to determine the steady-state loading profile of the system. Analyze power system performance two times as follows:
 - 1. Determine load flow and voltage drop based on full-load currents obtained in "Power System Data" Article.
 - 2. Determine load flow and voltage drop based on 80 percent of the design capacity of load buses.
 - 3. Prepare load-flow and voltage-drop analysis and report to show power system components that are overloaded, or might become overloaded; show bus voltages that are less than as prescribed by NFPA 70.

3.5 FIELD ADJUSTING

- A. Adjust relay and protective device settings according to recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of equipment manufacturer under the "Startup and Acceptance Testing" contract portion.
- B. Make minor modifications to equipment as required to accomplish compliance with protective device coordination studies.
- C. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification.
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

3.6 DEMONSTRATION

- A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in the following:

1. Acquaint personnel in fundamentals of operating the power system in normal and emergency modes.
2. Hand-out and explain the coordination study objectives, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting time-current coordination curves.
3. For Owner's maintenance staff certified as NETA ETT-Certified Technicians Level III or NICET Electrical Power Testing Level III Technicians, teach how to adjust, operate, and maintain overcurrent protective device settings.

END OF SECTION 26 05 73.16

SECTION 26 09 13 – ELECTRICAL POWER MONITORING AND CONTROL

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 the following for monitoring of electrical power system:
 - 1. PC-based workstation(s) and software. Software to be installed on client provided PC Terminal.
 - 2. Communication network and interface modules for TCP/IP data transmission protocols.
 - 3. HCAA currently utilizes an existing Schneider Electric StruxureWare – Power Monitoring Expert system. All devices indicated to be connected to the monitoring system shall be programmed into the existing system. If the successful manufacturer is other than Square D, Schneider Electric, a complete system including software shall be provided as specified

1.3 DEFINITIONS

- A. Ethernet: Local area network based on IEEE 802.3 standards.
- B. Firmware: Software (programs or data) that has been written onto read-only memory (ROM). Firmware is a combination of software and hardware. Storage media with ROMs that have data or programs recorded on them are firmware.
- C. HTML: Hypertext markup language.
- D. I/O: Input/output.
- E. KY Pulse: A term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay changing status in response to the rotation of the disk in the meter.
- F. LAN: Local area network; sometimes plural as "LANs."
- G. LCD: Liquid crystal display.
- H. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or remote-control, signaling and power-limited circuits.
- I. Modbus TCP/IP: An open protocol for exchange of process data.
- J. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.
- K. PC: Personal computer; sometimes plural as "PCs."
- L. rms: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.
- M. RS-232: A TIA standard for asynchronous serial data communications between terminal devices.

- N. RS-485: A TIA standard for multipoint communications using two twisted-pairs.
- O. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.
- P. THD: Total harmonic distortion.
- Q. UPS: Uninterruptible power supply; used both in singular and plural context.
- R. WAN: Wide area network.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Attach copies of approved Product Data submittals for products (such as switchboards and switchgear) that describe power monitoring and control features to illustrate coordination among related equipment and power monitoring and control.
- B. Shop Drawings: For power monitoring and control equipment. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Outline Drawings: Indicate arrangement of components and clearance and access requirements.
 - 2. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.
 - 3. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 4. Wiring Diagrams: For power, signal, and control wiring. Coordinate nomenclature and presentation with a block diagram.
 - 5. UPS sizing calculations for workstation.
 - 6. Surge suppressors: Data for each device used and where applied.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified manufacturer.
- B. Field quality-control reports.
- C. Other Informational Submittals:
 - 1. Manufacturer's system installation and setup guides, with data forms to plan and record options and setup decisions.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For power monitoring and control units, to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Operating and applications software documentation.
 - 2. Software licenses.
 - 3. Software service agreement.
 - 4. PC installation and operating documentation, manuals, and software for the PC and all installed peripherals. Software shall include system restore, emergency boot diskettes, and drivers for all installed hardware. Provide separately for each PC.
 - 5. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy submittal.

B. Software and Firmware Operational Documentation:

1. Self-study guide describing the process for setting equipment's network address; setting Owner's options; procedures to ensure data access from any PC on the network, using a standard Web browser; and recommended firewall setup.
2. Software operating and upgrade manuals.
3. Software Backup: On a magnetic media or compact disc, complete with Owner-selected options.
4. Device address list and the set point of each device and operator option, as set in applications software.
5. Graphic file and printout of graphic screens and related icons, with legend.

C. Software Upgrade Kit: For Owner to use in modifying software to suit future power system revisions or power monitoring and control revisions.

D. Software licenses and upgrades required by and installed for operating and programming digital and analog devices.

1.7 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.

1. Addressable Relays: One for every 10 installed. Furnish at least one of each type.
2. Data Line Surge Suppressors: One for every 10 of each type installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Manufacturer Qualifications: A firm experienced in manufacturing power monitoring and control equipment similar to that indicated for this Project and with a record of successful in-service performance.

C. 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.

1.9 COORDINATION

A. Coordinate features of distribution equipment and power monitoring and control components to form an integrated interconnection of compatible components.

1. Match components and interconnections for optimum performance of specified functions.

B. Coordinate Work of this Section with those in Sections specifying distribution components that are monitored or controlled by power monitoring and control equipment.

1.10 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for two years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include the operating systems. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 1. Schneider Electric - Power Management Operation.(Basis of Design)

2.2 FUNCTIONAL DESCRIPTION

- A. Instrumentation and Recording Devices: Monitor and record load profiles and chart energy consumption patterns.
 1. Calculate and Record the Following:
 - a. Load factor.
 - b. Peak demand periods.
 2. Measure and Record Metering Data for the Following:
 - a. Electricity.
- B. Software: Calculate allocation of utility costs.
 1. Automatically Import Energy Usage Records to Allocate Energy Costs for the Following:
 - a. At least 30 tenants.
- C. Power Quality Monitoring: Identify power system anomalies and measure, display, and record trends and alarms of the following power quality parameters:
 1. Voltage regulation and unbalance.
 2. Continuous three-phase rms voltage.
 3. Periodic max./min./avg. voltage samples.
 4. Harmonics.
 5. Voltage excursions.
- D. System: Report equipment status and power system control.

2.3 SYSTEM REQUIREMENTS

- A. Monitoring System: Include multiple PC-based workstations with graphics capability and Web access, with its operating system and application software, connected to data transmission network.
- B. Surge Protection: For external wiring of each conductor entry connection to components to protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads.
 1. Minimum Protection for Power Lines 120 V and More: Auxiliary panel suppressors complying with requirements in Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits."
 2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Comply with requirements as recommended by manufacturer for type of line being protected.
- C. Addressable Devices: All transmitters and receivers shall communicate unique device identification and status reports to monitoring and control clients.

- D. BAS Interface: Provide factory-installed hardware and software to enable the BAS to monitor, display, and record data for use in processing reports.
 - 1. Hardwired Monitoring Points: Electrical power demand (kilowatts), electrical power consumption (kilowatt-hours), power factor.

2.4 OPERATING SYSTEM

- A. Software: Configured for a server and multiple client PCs, each with capability for accessing multiple devices simultaneously. Software shall include interactive graphics client and shall be Web enabled. Workstations and portable computers shall not require any software except for an Internet browser to provide connectivity and full functionality. Include a firewall recommended by manufacturer. 100 Base-T Ethernet, Modbus TCP/IP RS-232, and RS-485 digital communications.
- B. Operating System Software: Based on **32bit**, Microsoft Windows workstation operating system. Software shall have the following features:
 - 1. Multiuser and multitasking to allow independent activities and monitoring to occur simultaneously at different workstations.
 - 2. Graphical user interface to show pull-down menus and a menu tree format.
 - 3. Capability for future additions within the indicated system size limits.
- C. Peer Computer Control Software: Shall detect a failure of workstation and associated server, and shall cause other workstation and associated server to assume control of all system functions without interruption of operation. Drivers shall be provided in both central computers to support this mode of operation.

2.5 APPLICATIONS SOFTWARE

- A. Basic Requirements:
 - 1. Fully compatible with and based on the approved operating system.
 - 2. Password-protected operator login and access; three levels, minimum.
 - 3. Password-protected setup functions.
 - 4. Context-sensitive online help.
 - 5. Capability of creating, deleting, and copying files; and automatically maintaining a directory of all files, including size and location of each sequential and random-ordered record.
 - 6. Capability for importing custom icons into graphic views to represent alarms and I/O devices.
 - 7. Automatic and encrypted backups for database and history; automatically stored at selected workstation and encrypted with a nine-character alphanumeric password, which must be used to restore or read data contained in backup.
 - 8. Operator audit trail for recording and reporting all changes made to user-defined system options.
- B. Workstation Server Functions:
 - 1. Support other client PCs on the LAN and WAN.
 - 2. Maintain recorded data in databases accessible from other PCs on the LAN and WAN.
- C. Data Formats:
 - 1. User-programmable export and import of data to and from commonly used Microsoft Windows spreadsheet, database, billing, and other applications; using dynamic data exchange technology.
 - 2. Option to convert reports and graphics to HTML format.
 - 3. Interactive graphics.
 - 4. Option to send preprogrammed or operator designed e-mail reports.
- D. Metered Data: Display metered values in real time.

- E. Equipment Documentation: Database for recording of equipment ratings and characteristics; with capability for graphic display on monitors.
- F. Graphics: Interactive color-graphics platform with pull-down menus and mouse-driven generation of power system graphics, in formats widely used for such drafting; to include the following:
 - 1. Site plan.
 - 2. Floor plans.
 - 3. Equipment elevations.
 - 4. Single-line diagrams.
- G. User-Defined Monitoring and Control Events: Display and record with date and time stamps accurate to 0.1 second, and including the following:
 - 1. Operator log on/off.
 - 2. Attempted operator log on/off.
 - 3. All alarms.
 - 4. Equipment operation counters.
 - 5. Out-of-limit, pickup, trip, and no-response events.
- H. Trending Reports: Display data acquired in real-time from different meters or devices, in historical format over user-defined time; unlimited as to interval, duration, or quantity of trends.
 - 1. Spreadsheet functions of sum, delta, percent, average, mean, standard deviation, and related functions applied to recorded data.
 - 2. Charting, statistical, and display functions of standard Windows-based spreadsheet.
- I. Alarms: Display and record alarm messages from discrete input and controls outputs, according to user programmable protocol.
 - 1. Functions requiring user acknowledgment shall run in background during computer use for other applications and override other presentations when they occur.
- J. Waveform Data: Display and record waveforms on demand or automatically on an alarm or programmed event. Include the graphic displays of the following, based on user-specified criteria:
 - 1. Phase voltages, phase currents, and residual current.
 - 2. Overlay of three-phase currents, and overlay each phase voltage and current.
 - 3. Waveforms ranging in length from 2cycles to 5 minutes.
 - 4. Disturbance and steady-state waveforms up to 512 points per cycle.
 - 5. Transient waveforms up to 83,333 points per cycle on 60-Hz base.
 - 6. Calculated waveform, based on recorded data, on a minimum of four cycles of data of the following:
 - a. THD.
 - b. rms magnitudes.
 - c. Peak values.
 - d. Crest factors.
 - e. Magnitude of individual harmonics.
- K. Data Sharing: Allow export of recorded displays and tabular data to third-party applications software.
 - 1. Tabular data shall be in the comma-separated values.
- L. Activity Billing Software:
 - 1. Automatically compute and prepare activity demand and energy-use statements based on metering of energy use and peak demand integrated over user-defined interval.
 - 2. Intervals shall be same as used by electric utilities, including current vendor.

3. Import metered data from saved records that were generated by metering and monitoring software.
4. Maintain separate directory for each activity's historical billing information.
5. Prepare summary reports in user-defined formats and time intervals.

M. Reporting: User commands initiate the reporting of a list of current alarm, supervisory, and trouble conditions in system or a log of past events.

1. Print a record of user-defined alarm, supervisory, and trouble events on workstation printer.
2. Sort and report by device name and by function.
3. Report type of signal (alarm, supervisory, or trouble), description, date, and time of occurrence.
4. Differentiate alarm signals from other indications.
5. When system is reset, report reset event with same information concerning device, location, date, and time.

2.6 COMMUNICATION COMPONENTS AND NETWORKS

A. Network Configuration: High-speed, multi-access, open nonproprietary, industry standard communication protocol; LANs complying with EIA 485, 100 Base-T Ethernet, and Modbus TCP/IP.

2.7 POWER MONITORS

A. Separately mounted, permanently installed instrument for power monitoring and control, complying with UL 1244.

1. Enclosure: NEMA 250, Type 1

B. Environmental Conditions: System components shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Indoor installation in non-air-conditioned spaces that have environmental controls to maintain ambient conditions of 0 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing.

C. rms Real-Time Measurements:

1. Current: Each phase, neutral, average of three phases, percent unbalance.
2. Voltage: Line-to-line each phase, line-to-line average of three phases, line-to-neutral each phase, line-to-neutral average of three phases, line-to-neutral percent unbalance.
3. Power: Per phase and three-phase total.
4. Reactive Power: Per phase and three-phase total.
5. Apparent Power: Per phase and three-phase total.
6. Power Factor: Per phase and three-phase total.
7. Displacement Power Factor: Per phase and three-phase total.
8. Frequency.
9. THD: Current and voltage.
10. Accumulated Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).
11. Incremental Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).
12. Conditional Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).

D. Demand Current Calculations, per Phase, Three-Phase Average and Neutral:

1. Present.
2. Running average.
3. Last completed interval.
4. Peak.

E. Demand Real Power Calculations, Three-Phase Total:

1. Present.
2. Running average.
3. Last completed interval.
4. Predicted.
5. Peak.
6. Coincident with peak kVA demand.
7. Coincident with kVAR demand.

F. Demand Reactive Power Calculations, Three-Phase Total:

1. Present.
2. Running average.
3. Last completed interval.
4. Predicted.
5. Peak.
6. Coincident with peak kVA demand.
7. Coincident with kVAR demand.

G. Demand Apparent Power Calculations, Three-Phase Total:

1. Present.
2. Running average.
3. Last completed interval.
4. Predicted.
5. Peak.
6. Coincident with peak kVA demand.
7. Coincident with kVAR demand.

H. Average Power Factor Calculations, Demand Coincident, Three-Phase Total:

1. Last completed interval.
2. Coincident with kW peak.
3. Coincident with kVAR peak.
4. Coincident with kVA peak.

I. Power Analysis Values:

1. THD, Voltage and Current: Per phase, three phase, and neutral.
2. Displacement Power Factor: Per phase, three phase.
3. Fundamental Voltage, Magnitude and Angle: Per phase.
4. Fundamental Currents, Magnitude and Angle: Per phase.
5. Fundamental Real Power: Per phase, three phase.
6. Fundamental Reactive Power: Per phase.
7. Harmonic Power: Per phase, three phase.
8. Phase rotation.
9. Unbalance: Current and voltage.
10. Harmonic Magnitudes and Angles for Current and Voltages: Per phase, up to 31st harmonic.

J. Power Demand Calculations: According to one of the following calculation methods, selectable by the user:

1. Thermal Demand: Sliding window updated every second for the present demand and at end of the interval for the last interval. Adjustable window that can be set in 1-minute intervals, from 1 to 60 minutes.
2. Block Interval with Optional Subintervals: Adjustable for 1-minute intervals, from 1 to 60 minutes. User-defined parameters for the following block intervals:
 - a. Sliding block that calculates demand every second, with intervals less than 15 minutes, and every 15 seconds with an interval between 15 and 60 minutes.

- b. Fixed block that calculates demand at end of the interval.
 - c. Rolling block subinterval that calculates demand at end of each subinterval and displays it at end of the interval.
- 3. Demand Calculation Initiated by a Synchronization Signal:
 - a. Signal is a pulse from an external source. Demand period begins with every pulse. Calculation shall be configurable as either a block or rolling block calculation.
 - b. Signal is a communication signal. Calculation shall be configurable as either a block or rolling block calculation.
 - c. Demand can be synchronized with clock in the power meter.
- K. Sampling:
 - 1. Current and voltage shall be digitally sampled at a rate high enough to provide accuracy to 63rd harmonic of 60-Hz fundamental.
 - 2. Power monitor shall provide continuous sampling at a rate of 128 samples per cycle on all voltage and current channels in the meter.
- L. Minimum and Maximum Values: Record monthly minimum and maximum values, including date and time of record. For three-phase measurements, identify phase of recorded value. Record the following parameters:
 - 1. Line-to-line voltage.
 - 2. Line-to-neutral voltage.
 - 3. Current per phase.
 - 4. Line-to-line voltage unbalance.
 - 5. Line-to-neutral voltage unbalance.
 - 6. Power factor.
 - 7. Displacement power factor.
 - 8. Total power.
 - 9. Total reactive power.
 - 10. Total apparent power.
 - 11. THD voltage L-L.
 - 12. THD voltage L-N.
 - 13. THD current.
 - 14. Frequency.
- M. Harmonic Calculation: Display and record the following:
 - 1. Harmonic magnitudes and angles for each phase voltage and current through 31st >harmonic. Calculate for all three phases, current and voltage, and residual current. Current and voltage information for all phases shall be obtained simultaneously from same cycle.
 - 2. Harmonic magnitude reported as a percentage of the fundamental or as a percentage of rms values, as selected by user.
- N. Current and Voltage Ratings:
 - 1. Designed for use with current inputs from standard instrument current transformers with 5-A secondary and shall have a metering range of 0-10 A.
 - 2. Withstand ratings shall not be less than 15 A, continuous; 50 A, lasting over 10 seconds, no more frequently than once per hour; 500 A, lasting 1 second, no more frequently than once per hour.
 - 3. Designed for use with voltage inputs from standard instrument potential transformers with a 120-V secondary.
- O. Accuracy:

1. Comply with ANSI C12.20, Class 0.5; and IEC 60687, Class 0.5 for revenue meters. Accuracy from Light to Full Rating shall meet the following criteria:
 - a. Power: Accurate to 0.25 percent of reading, plus 0.025 percent of full scale.
 - b. Voltage and Current: Accurate to 0.075 percent of reading, plus 0.025 percent of full scale.
 - c. Power Factor: Plus or minus 0.002, from 0.5 leading to 0.5 lagging.
 - d. Frequency: Plus or minus 0.01 Hz at 45 to 67 Hz.
2. For meters that are circuit-breaker accessories, metering accuracy at full-scale shall not be less than the following:
 - a. Current: Plus or minus 2.5 percent.
 - b. Voltage: Plus or minus 1.5 percent.
 - c. Energy, Demand, and Power: Plus or minus 4.0 percent.
 - d. Frequency: Plus or minus 1 Hz.

P. Waveform Capture:

1. Capture and store steady-state waveforms of voltage and current channels; initiated manually. Each capture shall be for 3 data points for each cycle, allowing resolution of harmonics to 31st harmonic of basic 60 Hz.
2. Store captured waveforms in internal nonvolatile memory; available for PC display, archiving, and analysis.

Q. Input: One digital input signal(s).

1. Normal mode for on/off signal.
2. Demand interval synchronization pulse, accepting a demand synchronization pulse from a utility demand meter.
3. Conditional energy signal to control conditional energy accumulation.

R. Outputs:

1. Operated either by user command sent via communication link, or set to operate in response to user-defined alarm or event.
2. Closed in either a momentary or latched mode as defined by user.
3. Each output relay used in a momentary contact mode shall have an independent timer that can be set by user.
4. One digital KY pulse to a user-definable increment of energy measurement. Output ratings shall be up to 120-V ac, 300-V dc, 50 mA, and provide 3500-V rms isolation.
5. **One** relay output module(s), providing a load voltage range from 20- to 240-V ac or from 20- to 30-V dc, supporting a load current of 2 A.
6. Output Relay Control:
 - a. Relay outputs shall operate either by user command sent via communication link or in response to user-defined alarm or event.
 - b. Normally open and normally closed contacts, field configured to operate as follows:
 - 1) Normal contact closure where contacts change state for as long as signal exists.
 - 2) Latched mode when contacts change state on receipts of a pickup signal; changed state is held until a dropout signal is received.
 - 3) Timed mode when contacts change state on receipt of a pickup signal; changed state is held for a preprogrammed duration.
 - 4) End of power demand interval when relay operates as synchronization pulse for other devices.
 - 5) Energy Pulse Output: Relay pulses quantities used for absolute kWh, absolute kVARh, kVAh, kWh In, kVARh In, kWh Out, and kVARh Out.
 - 6) Output controlled by multiple alarms using Boolean-type logic.

S. Onboard Data Logging:

1. Store logged data, alarms, events, and waveforms in 800 KB of onboard nonvolatile memory.
2. Stored Data:
 - a. Billing Log: User configurable; data shall be recorded every 15 minutes, identified by month, day, and 15-minute interval. Accumulate 24 months of monthly data, 32 days of daily data, and between 2 and 52 days of 15-minute interval data, depending on number of quantities selected.
 - b. Custom Data Logs: Three user-defined log(s) holding up to 96 parameters. Date and time stamp each entry to the second and include the following user definitions:
 - 1) Schedule interval.
 - 2) Event definition.
 - 3) Configured as "fill-and-hold" or "circular, first-in first-out."
 - c. Alarm Log: Include time, date, event information, and coincident information for each defined alarm or event.
 - d. Waveform Log: Store captured waveforms configured as "fill-and-hold" or "circular, first-in first-out."
3. Default values for all logs shall be initially set at factory, with logging to begin on device power up.

T. Alarms.

1. User Options:
 - a. Define pickup, dropout, and delay.
 - b. Assign one of four severity levels to make it easier for user to respond to the most important events first.
 - c. Allow for combining up to four alarms using Boolean-type logic statements for outputting a single alarm.
2. Alarm Events:
 - a. Over/undercurrent.
 - b. Over/undervoltage.
 - c. Current imbalance.
 - d. Phase loss, current.
 - e. Phase loss, voltage.
 - f. Voltage imbalance.
 - g. Over kW demand.
 - h. Phase reversal.
 - i. Digital input off/on.
 - j. End of incremental energy interval.
 - k. End of demand interval.

U. Control Power: 90- to 457-V ac or 100- to 300-V dc.

V. Communications:

1. Power monitor shall be permanently connected to communicate via Modbus TCP via a 100 Base-T Ethernet.
2. Local plug-in connections shall be for RS-232 and 100 Base-T Ethernet.

2.8 RS-232 ASCII INTERFACE

- A. ASCII interface shall allow RS-232 connections to be made between a meter or circuit monitor operating as the host PC and any equipment that will accept RS-232 ASCII command strings, such as local display panels
- B. Alarm System Interface:
 - 1. RS-232 output shall be capable of transmitting alarms from other monitoring and alarm systems to workstation software.
- C. Cables:
 - 1. PVC-Jacketed, RS-232 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, and individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage; PVC jacket. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
 - a. NFPA 70, Type CM.
 - b. Flame Resistance: UL 1581, Vertical Tray.
 - 2. Plenum-Type, RS-232 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, and individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage; plastic jacket. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
 - a. NFPA 70, Type CMP.
 - b. Flame Resistance: NFPA 262, Flame Test.

2.9 LAN CABLES

- A. Comply with Section 271500 "Communications Horizontal Cabling."
- B. RS-485 Cable:
 - 1. PVC-Jacketed, RS-485 Cable: Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, PVC insulation, unshielded, PVC jacket, and NFPA 70, Type CMG.
 - 2. Plenum-Type, RS-485 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and fluorinated-ethylene-propylene jacket, and NFPA 70, Type CMP.
- C. Unshielded Twisted Pair Cables: Category 5e as specified for horizontal cable for data service in Section 271500 "Communications Horizontal Cabling."

2.10 LOW-VOLTAGE WIRING

- A. Comply with Section 260523 "Control-Voltage Electrical Power Cables."
- B. Low-Voltage Control Cable: Multiple conductor, color-coded, No. 20 AWG copper, minimum.
 - 1. Sheath: PVC; except in plenum-type spaces, use sheath listed for plenums.
 - 2. Ordinary Switching Circuits: Three conductors unless otherwise indicated.
 - 3. Switching Circuits with Pilot Lights or Locator Feature: Five conductors unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CABLING

- A. Comply with NECA 1.
- B. Install cables and wiring according to requirements in Section 271500 "Communications Horizontal Cabling."
- C. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters. Conceal raceway and wiring except in unfinished spaces.
- D. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use NRTL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.
- E. Install LAN cables using techniques, practices, and methods that are consistent with specified category rating of components and that ensure specified category performance of completed and linked signal paths, end to end.
- F. Install cables without damaging conductors, shield, or jacket.

3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."
- B. Label each power monitoring and control module with a unique designation.

3.4 GROUNDING

- A. Comply with IEEE 1100, "Recommended Practice for Powering and Grounding Electronic Equipment."

3.5 FIELD QUALITY CONTROL

- A. Testing Agency. Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:

1. Electrical Tests: Use caution when testing devices containing solid-state components.
 2. Continuity tests of circuits.
 3. Operational Tests: Set and operate controls at workstation and at monitored and controlled devices to demonstrate their functions and capabilities. Use a methodical sequence that cues and reproduces actual operating functions as recommended by manufacturer. Submit sequences for approval. Note response to each test command and operation. Note time intervals between initiation of alarm conditions and registration of alarms at central-processing workstation.
 - a. Coordinate testing required by this Section with that required by Sections specifying equipment being monitored and controlled.
 - b. Test LANs according to requirements in Section 271500 "Communications Horizontal Cabling."
 - c. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of calculated battery operating time.
 - d. Verify accuracy of graphic screens and icons.
 - e. Metering Test: Load feeders, measure loads on feeder conductor with an rms reading clamp-on ammeter, and simultaneously read indicated current on the same phase at central-processing workstation. Record and compare values measured at the two locations. Resolve discrepancies greater than 5 percent and record resolution method and results.
 - f. Record metered values, control settings, operations, cues, time intervals, and functional observations and submit test reports printed by workstation printer.
- E. Power monitoring and control equipment will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Correct deficiencies, make necessary adjustments, and retest. Verify that specified requirements are met.
- H. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.
- I. Reports: Written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.
- J. Remove and replace malfunctioning devices and circuits and retest as specified above.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain systems. See Section 017900 "Demonstration and Training."
1. Train Owner's management and maintenance personnel in interpreting and using monitoring displays and in configuring and using software and reports. Include troubleshooting, servicing, adjusting, and maintaining equipment. Provide a minimum of 24 hours' training.
 2. Training Aid: Use approved final versions of software and maintenance manuals as training aids.

3.7 ON-SITE ASSISTANCE

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION 26 09 13

SECTION 26 09 43 – NETWORK LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

1.1 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. The BAS Controls Contractor shall furnish the integrated lighting control system as indicated per the specifications and drawings. The integrated lighting control system includes, but is not limited to, lighting control panels, relays, low voltage light level sensors (interior).

1.2 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. None

1.3 PRODUCTS NOT FURNISHED OR INSTALLED BUT INTEGRATED WITH THE WORK OF THIS SECTION

- A. Operator interface

1.4 RELATED SECTIONS

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents.
- B. The following sections constitute related work:
 - 1. Section 26 10 00 – Basic Electrical Requirements
 - 2. Section 26 51 00 - Lighting

1.5 DESCRIPTION

- A. General: The integrated lighting control system shall consist of lighting controllers that reside directly on the N2 DDC controller network. The lighting controllers shall interface with a variety of low voltage field devices (low voltage switches, photocells, or any dry contact devices) to provide local control and override. As an integrated system, lighting control functions shall be controlled and monitored through the DDC control system operator interface.
- B. Operators shall be able to perform all normal operator functions through a single operator interface.
- C. The system shall directly control the lighting zones as specified in Section 3.15 – Sequence of Operations for Lighting Controls. Each zone controller shall provide occupied and unoccupied modes of operation by individual zone.
- D. The system shall provide for future system expansion and updates through field firmware upgrades.
- E. The system shall use the N2 protocol for communication on the DDC network. I/O points, schedules, set points, trends, and alarms specified in Section 3.15– "Sequence of Operations for Lighting Controls" shall be N2 objects.

1.6 APPROVED PRODUCTS AND SUPPLIERS

The following are approved control system suppliers, manufacturers, and product lines:

Manufacturer	Product Line
Hubbell	NX

Manufacturer	Product Line
Lutron	Quantum
Pharos	LPC

Substitutions are permitted as voluntary alternates. Base bid must reflect the specified equipment.

- A. A product must go through the following process before being approved as a substitution:
- B. A list of substitutions shall be provided to the owner as an attachment to the bid form. Submit along with bill of material, CD of proposed operating system, and a one line diagram of the system configuration proposed indicating the type, size and number of conductors between each component and interconnection and compatibility with the existing Johnson Control Metasys system.

1.7 QUALITY ASSURANCE

- A. Supplier and Manufacturer Qualifications
 - 1. Supplier shall have an established working relationship with the Integrated Lighting Control Manufacturer.
 - 2. Supplier shall have successfully completed the Integrated Lighting Control Manufacturer's system training. Upon request, Supplier shall present record of completed training including course outlines and dated certificate.

1.8 CODES AND STANDARDS

- A. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authorities' codes and ordinances or these plans and specifications. As a minimum, the installation shall comply with current editions in effect 30 days prior to receipt of bids of the following codes:
 - 1. National Electric Code (NEC)
 - 2. International Building Code (IBC)
 - a. International Energy Conservation Code (IECC)
 - 3. ANSI/ASHRAE 135-2004: Data Communication Protocol for Building Automation and Control Systems (N2)

1.9 SUBMITTALS

- A. Product Submittal Requirements: Meet requirements of Section 01 30 00 on Shop Drawings, Product Data, and Samples. Provide six copies of shop drawings and other submittals on hardware, software, and equipment to be installed or furnished. Begin no work until submittals have been approved for conformity with design intent. Provide drawings as AutoCAD 2006 (or newer) compatible files on magnetic or optical disk (file format: .DWG, .DXF, .VSD, or comparable) and 3 prints of each drawing on 11" x 17" paper. When manufacturer's cut sheets apply to a product series rather than a specific product, clearly indicate applicable data by highlighting or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work. Submittal approval does not relieve Contractor of responsibility to supply sufficient quantities to complete work.
- B. Schedules
 - 1. Schedule of work provided within one month of contract award, indicating:
 - a. Intended sequence of work items
 - b. Start date of each work item
 - c. Duration of each work item
 - d. Planned delivery dates for ordered material and equipment and expected lead times
 - e. Milestones indicating possible restraints on work by other trades or situations

2. Monthly written status reports indicating work completed and revisions to expected delivery dates. Include updated schedule of work.
- C. Project Record Documents. Submit three copies of record (as-built) documents upon completion of installation for approval prior to final completion. Submittal shall consist of:
 1. Project Record Drawings. As-built versions of submittal shop drawings provided as AutoCAD 2006 (or newer) compatible files on magnetic or optical disk (file format: .DWG, .DXF, .VSD, or comparable) and 6 prints of each drawing on 11" x 17" paper.
 2. Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs used to meet requirements of Section 26 05 70 Article 3.17 (Control System Demonstration and Acceptance).
 3. Operation and Maintenance (O&M) Manual. Printed, electronic, or online help documentation of the following:
 - a. As-built versions of submittal product data.
 - b. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
 - c. Documentation of programs created using custom programming language including set points, tuning parameters, and object database. Electronic copies of programs shall meet this requirement if control logic, set points, tuning parameters, and objects can be viewed using furnished programming tools.
 - d. List of recommended spare parts with part numbers and suppliers.
 - e. Licenses, guarantees, and warranty documents for equipment and systems.
 - f. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.

1.11 WARRANTY

- A. Warrant work as follows:
 1. Warrant materials for specified control system free from defects for a period of 24 months after final acceptance. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional material cost to Owner. Contact manufacturer representative for pre-authorization of any replacement material and return procedures.
 2. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.
 3. If Engineer determines that equipment and systems operate satisfactorily at the end of final start-up, testing, and commissioning phase, Engineer will certify in writing that control system operation has been tested and accepted in accordance with the terms of this specification. Date of acceptance shall begin warranty period.
 4. Provide updates to lighting controller firmware that resolve Contractor-identified deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.
 5. Exception: Contractor shall not be required to warrant reused devices except those that have been rebuilt or repaired. Installation labor and materials shall be warranted. Demonstrate operable condition of reused devices at time of Engineer's acceptance.

1.12 OWNERSHIP OF PROPRIETARY MATERIAL

- A. Project-specific software and documentation shall become Owner's property. This includes, but is not limited to:
 1. Graphics
 2. Record drawings
 3. Database
 4. Documentation

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide new products the manufacturer is currently manufacturing and selling for use in new installations.
- B. Manufacturer shall offer spare or equivalent parts for at least two years after completion of this contract.
Spare parts include:
 - A. Control panel relays
 - B. Control panel dimming modules
 - C. Control panel electronics
 - D. Control panel transformer
- C. Manufacturer shall offer repair services or replacement parts for at least two years after completion of this contract.

2.2 COMMUNICATION

- A. With or without the use of gateways, media converters, or other accessories, the lighting control system shall be capable of connection to the following networks:
 - 1. Johnson Controls N2
 - 2. BACnet.
- B. The lighting control system shall be capable of accepting commands from the networks referenced in section "A" above.
- C. The lighting control system shall be capable of being monitored from the networks referenced in section "A" above.
- D. For BACnet integration functionality requirements, refer to section 2.9D.

2.3 OPERATOR INTERFACE

- A. Shall be provided by the BAS Control contractor per Section: 23 09 00.

2.4 LIGHTING CONTROL PANEL – GENERAL REQUIREMENTS

- A. Provide lighting control panels with configurations as indicated on the drawings.
- B. Listed to UL 508 as industrial control equipment.
- C. Comply with UL 508A and IEC 60669-2-1 as applicable.
- D. To acquire UL listing on field-assembled panels, a UL inspector must test the installed equipment on site. This will add costs to the project and could result in delays. Factory assembled panels are fully tested and UL listed when delivered to the site. These pre-assembled panels can be quickly installed and eliminate potential assembly errors in the field, saving installation costs.
- E. Delivered and installed as a listed factory-assembled panel.
- F. If panel components are removed and reassembled in the field, the UL listing is voided. To regain the UL listing, the field-assembled panel must be reinspected by a UL inspector.
- G. Field wiring accessible from front of panel without removing dimmer assemblies or other components.
- H. Passively cooled via free-convection, unaided by fans or other means.
- I. Shipped with each dimmer in mechanical bypass position by means of jumper bar inserted between input and load terminals. Jumpers to carry full rated load current and be reusable at any time. Mechanical bypass device to allow for switching operation of connected load with dimmer removed by means of circuit breaker.
- J. Provided with branch circuit protection for each input circuit unless the panel is a dedicated feed-through type panel or otherwise indicated on the drawings.
- K. Provide panels with listed short circuit current rating not less than the available fault current as indicated on the drawings.

- L. Minimum Short Circuit Current Rating (SCCR): 25,000 A.
- M. To provide the installing contractor and end user an interface to change load types, circuit assignments, and these specific characteristics without the need for additional parts and components, the following panel processor should be specified.
- N. Provide the following processor capabilities:
 - 1. Operate circuit directly from panel processor for system diagnostics and provide feedback of system operation.
 - 2. Electronically assign each circuit to any zone in lighting control system.
- O. Diagnostics and Service:
 - 1. Replacing dimmer/relay does not require re-programming of system or processor.
 - 2. Include diagnostic LEDs for dimmers/relays to verify proper operation and assist in system troubleshooting.
 - 3. If lighting control system fails, lights to remain at current level. Panel processor provides local control of lights until system is repaired.
 - 4. If panel processor fails, lights to remain at current level. Circuit breakers can be used to turn lights off or to full light output, allowing non-dim control of lights until panel processor is repaired.
 - 5. If dimmer fails, factory-installed mechanical bypass jumpers to allow each dimmer to be mechanically bypassed. Mechanical bypass device to allow for switching operation of connected load with dimmer removed by means of circuit breaker.

2.5 LIGHTING CONTROL PANEL – UNI-BODY INTERIOR

- A. General. The lighting control panel uni-body interior shall be manufactured with a minimum of 18 gauge C.R.S. that is treated to prevent corrosion and is powder coated.
- B. The uni-body interior provides separation of line voltage and low voltage wiring.
- C. The uni-body interior provides an odd / even relay orientation that matches standard panelboard
- D. The uni-body interior shall be available for the following relay and/or dimming module capacities; 8 / 16 / 24.
- E. The uni-body interior shall be available for installation after rough-in using stud mounting in the enclosure
- F. The uni-body interior shall provide a dual tap control power transformer; 120VAC or 277VAC, 40VA, 50-60hz. The control power transformer shall be an inherently limited UL Listed component.

2.6 LIGHTING CONTROL PANEL – CONTROLLER

- A. General. The controller shall be digital, microprocessor-based, and expandable.
- B. Communication.
 - 1. With or without the use of gateways, media converters, or other accessories, the controller shall be capable of connection to the following networks: Johnson Controls N2, BACnet.
 - 2. Service Port. Each controller shall provide a service communication port for connection to a Portable Operator's Terminal.
 - 3. Stand-Alone Operation. In the event of communication failure, each controller that has been programmed and that has a local schedule shall provide stand-alone operation for overrides and schedules.
- C. Environment. Controller hardware shall be suitable for anticipated ambient conditions.
 - 1. Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at 0°C to 50°C (32°F to 125°F). 20% - 95% RH, Non-condensing.
 - 2. Controllers used in conditioned space shall be mounted in NEMA 1 enclosures and shall be rated for operation at 0°C to 50°C (32°F to 125°F).
- D. Real-Time Clock. Controllers that perform scheduling shall have a real-time clock.
- E. Serviceability.
 - 1. Controllers shall have diagnostic LEDs for power, processing (run and error), communication (Tx and Rx for each network), and operation (auto and override).
 - 2. Wires shall be connected to a field-removable modular terminal strip or to a termination card connected by a ribbon cable.

3. Each controller shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation.
- F. Memory.
1. Controller memory shall support operating system, database, and programming requirements.
 2. Controller shall retain all memory for at least 72 hours in the event of power loss. After 72 hours all memory, except trends and time, shall be retained for a minimum of 60 days.
 - a. Time shall be restored after power-up
 - b. Trends shall be saved to the building automation system server to minimize any losses
- G. Immunity to Power and Noise.
1. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 feet.
- H. Addressing.
1. Shall be via visible rotary switches with decimal representation.
- I. Certifications:
1. Electronics meet or exceed IEC Level 3 standards:
 - a. Radiated Emissions, IEC 55022, Class A
 - b. Conducted Emissions, IEC 55022, Class A
 - c. Quasi-Stationary Current Harmonics, IEC 6100-3-2
 - d. Voltage Fluctuation and Flicker, IEC 6100-3-2
 - e. Electrostatic Discharge, IEC 61000-4-2
 - f. Electrical Fast Transient/Burst, IEC 6100-4-4
 - g. Surge Immunity, IEC 6100-4-5
 - h. Immunity to Conducted Disturbance, IEC 6100-4-6
 - i. Immunity to Voltage Dips, Short Interruptions, Voltage Variations, IEC 6100-4-11
 - j. Electromagnetic Compatibility Generic Immunity Standard. Part 1, IEC 6100-6-1
 - k. ISO 9001
 2. Regulatory – Panel assembly shall meet or exceed standards
 - a. Underwriters Laboratories UL 916, Standard for Energy Management Equipment
 - b. FCC, Part 15, Class A Radiated Emissions
 - c. FCC, Part 15, Class A Conducted Emissions
 - d. CEC Title 24
 - e. Optional: Underwriters Laboratories UL 924, Standard for Emergency Lighting Control (NFPA70)
- J. Low Voltage Switch Inputs
1. General: Each lighting control panel shall be provided with a minimum of 24 two-wire, on-board switch inputs. All switch inputs shall be terminated inside the low voltage section of the lighting control panel.
 2. Protection: Maximum allowable voltage on switch input terminals (continuous): 30VDC.
 3. Switch Input Wiring
 - a. Dry-contact Mode (Normal): The maximum wire length between the device and the input at AWG #18 is 500 feet.
 - b. Wet-contact Mode (Powered): The maximum wire length between the device and the input 1,000 feet using AWG #18 wire.
 4. Switch Input Modes: Through field configuration (hardware) the controller shall support the following modes:
 - a. Dry-contact Mode (Normal):
 - A. Switch inputs field configured for dry contact shall sense contact closure without the application of an external power source.
 - B. Switch inputs field configured for dry contact shall be protected against contact bounce and noise.
 - b. Wet-Contact Mode (Powered):
 - A. Switch inputs field configured for externally powered contact shall accept between 12 VDC and 28VDC and shall be protected against contact bounce and noise.

5. Switch Input Types: Through field configuration (software) the following switch types shall be supported in either dry contact or externally powered modes:
 - a. Maintained: leading edge trigger for ON and trailing edge trigger for OFF.
 - b. Momentary On: leading edge trigger for ON.
 - c. Momentary Off: leading edge trigger for OFF.
 - d. Momentary On/Off: leading edge trigger for ON and OFF. Each leading edge shall trigger the event in controller opposite of the current group status.
 - e. State Change: leading or trailing edge trigger for ON or OFF. Each leading or falling edge shall trigger the event in the controller opposite of the current group status.
 6. Switch Input Polarity: Through field configuration (software) each switch input shall be capable of accepting a “normally open” or “normally closed” contact in either dry contact or externally powered modes.
 7. Switch Input Link: Through field configuration (software) switch inputs shall be capable of being linked to any relay or relays in the same relay panel.
- K. Low Voltage Analog Input
1. General: Each lighting control panel shall be provided with a minimum of 6 three-wire, self-powered analog inputs. All analog inputs shall be terminated inside the low voltage section of the lighting control panel.
 2. Analog Input Wiring:
 - a. The maximum wire length between the device and the input at AWG #18 is 250 feet.

2.7 LIGHTING CONTROL PANEL – RELAYS

- A. Provide the appropriate quantity of relays required to accommodate the lighting control and circuitry scheme indicated on the drawings.
- B. General: Relay shall be a UL Listed component. Each relay shall be SPST, dual-coil latching relay with a manual override lever. The relay shall be rated for the following:
 - A. 20 amp Tungsten @ 125VAC
 - B. 20 amp Ballast @ 120VAC
 - C. 20 amp Ballast @ 277VAC
 - D. 20 amp LED @ 125VAC
 - E. 20 amp LED @ 277VAC
 - F. 20 amp receptacles @ 125VAC
 - G. 1.5 Horse Power @ 120VAC
- C. Each relay terminal shall be a box clamp style field connection with the capacity to accept:
 - A. One 14 – 8 AWG wire, solid or stranded, copper only
 - B. Two 10 AWG wires, solid or stranded, copper only
- D. Each relay terminal screw is compatible with a Slotted, Phillips and Square drive.
- E. Each relay shall be individually replaceable and shall directly connect to the relay interface board without the use of wires or soldering. Relay blanks shall be provided for each unpopulated relay slot.
- F. Each relay shall be rated for a minimum of 300,000 on and off cycles at full load.

2.8 LIGHTING CONTROL PANEL – DIMMING MODULES

- A. Provide the appropriate quantity of dimming modules required to accommodate the lighting control and circuitry scheme indicated on the drawings.
- B. Dimming modules shall be designed and tested specifically to control LED, incandescent/tungsten, magnetic low voltage, electronic low voltage, fluorescent dimming ballasts, and non-dimmable loads.
- C. Dimming modules shall be rated for a continuous load of 16 A.
- D. Provide dimming modules compatible with the dimming technology (0-10V, phase control, ELV, etc.) type required by their associated loads. Load faults only affect the associated lighting branch circuit.

2.9 LIGHTING CONTROL PANEL ACCESSORIES

- A. Low Voltage Switches

1. Provide low voltage switches as detailed on the drawings.
 2. Low voltage switches shall be gangable with other standard or decora-style devices under a common face plate.
 3. Low voltage switches shall include device mounting screws
 4. Low voltage switches shall wire directly to low voltage input terminals on the controller.
- B. Low Voltage Light Level Sensors for Automatic Daylight Harvesting
1. Provide low voltage light level sensors as detailed on the drawings.
 2. Sensors shall be rated for the following ambient illumination levels:
 - a. Minimum: 0 footcandles
 - b. Maximum: 500 footcandles
 3. Sensors shall have a nominal operating voltage of 20VDC and a maximum analog output signal of 5mA.
 4. Sensors shall connect directly to the analog input terminals on the controller. Where required for connection to the lighting control system, provide interface modules per the manufacturer's instructions.
 5. Sensors shall be capable of remote calibration and/or programming via one (1) or a combination of the following:
 - a. Bluetooth
 - b. IR
 - c. Lighting control panel
 6. Sensors shall be constructed with resistivity to electrostatic discharge in accordance with IEC 801-2.
- C. Ethernet Interface
1. For each lighting control panel indicated on the drawings, provide an Ethernet interface for the integration of the lighting control system with the building automation system (BAS).
 2. Interface shall allow for the control and monitoring of the lighting control system.
 3. Provide N2-to-BACnet gateways (As required).
- D. BACnet integration software license
1. Provide software licenses, as required by the lighting control system manufacturer, for integration with the building automation system (BAS) via BACnet.
 2. Provide ability to communicate by means of native BACnet IP communication (does not require interface) to lighting control system from a user-supplied 10BASE-T or 100BASE-T Ethernet network.
 3. Requires only one network connection per system.
 4. Lighting control system to be BACnet Test Laboratory (BTL) listed.
 5. The BACnet integrator shall be capable of commanding the following:
 - a. Area light output.
 - b. Area enable or disable after hours mode.
 - c. Area load shed level.
 - d. Area load shed enable/disable.
 - e. Area shade group presets and levels.
 - f. Automated solar adaptive shade control.
 - g. Cloudy day/shadow override mode for automated shade control.
 - h. Brightness override mode for automated shade control.
 - i. Area occupancy sensors.
 - j. Area daylighting.
 - k. Daylighting level.
 - l. Area occupied and unoccupied level
 - m. Occupancy sensor timeouts.
 6. The BACnet integrator shall be capable of monitoring the following:
 - a. Area on/off status.
 - b. Area occupancy status.
 - c. Area fault.
 - d. Lamp failures.
 - e. Control devices not responding.
 - f. Area load shed status.

- g. Area instantaneous energy usage and maximum potential power usage.
- h. Area shade group presets and levels.
- i. Cloudy day and shadow sensor status.
- j. Light levels from window mounted sensors.
- k. Status of automated solar adaptive shade control.
- l. Status of cloudy day/shadow override for automated shade control.
- m. Status of brightness override for automated shade control.
- n. Area occupancy sensors.
- o. Daylighting.
- p. Timeclocks.
- q. Daylighting level.
- r. Area occupied and unoccupied level.
- s. Occupancy sensor timeouts.

2.10DMX LIGHTING CONTROLLER – GENERAL REQUIREMENTS

- A. The Controller shall be a microprocessor-based system specifically designed for control of lighting in an architectural or entertainment application.
- B. The Controller shall store show data in non-volatile solid-state memory. This memory shall be removable for purposes of backup or disaster-recovery.
- C. Show data may be downloaded from a remote personal computer over an Ethernet or USB connection.
- D. The Operating Software of the Controller shall be stored in a dedicated non-removable non-volatile solid-state memory. It shall be possible to update the Operating Software by download from a remote personal computer over an Ethernet or USB connection.
- E. The Controller shall commence show playback automatically on receiving power without additional external inputs.
- F. The Controller shall have an internal real-time clock that continues to operate when external power is absent. It shall be capable of adjusting for Daylight Savings Time automatically and can be updated over the Internet using the Network Time Protocol (NTP).
- G. The Controller shall be able to calculate sunrise and sunset times based on longitude and latitude information, and use these as triggers for events.
- H. The Controller shall have a capacity of 2048 output control channels.
- I. The Controller shall be able to output up to 1024 channels as DMX512 with RDM.
- J. The Controller shall be able to output multiple eDMX protocols simultaneously, including Art-Net II, KiNet, sACN and Pathport, up to the output control channel limit.
- K. The Controller shall be able to output DMX512 and eDMX protocols simultaneously, up to the output control channel limit.
- L. The Controller shall be able to output eDMX protocols on a different IP network to its management IP network.
- M. There shall be visual indicators on the Controller showing status of the controller and its interfaces.
- N. The Controller shall operate a web server on its Ethernet interface. This shall allow status information, control and configuration options to be accessed remotely.
- O. The appearance and content of the web interface may be customized by the user.
- P. The Controller shall allow lighting to be programmed as separate zones, with independent triggering and manual intensity control.
- Q. The Controller shall support multiple timelines, crossfades and effects running concurrently.
- R. The Controller shall support playback of video media with individual pixels mapped to lighting fixtures in an array.
- S. The Controller shall support a multi-mode full-duplex RS232/half-duplex RS485 serial port.
- T. The Controller shall be capable of receiving DMX512 for triggering.
- U. The Controller shall support 8 local inputs capable of digital, analogue or contact closure operating modes.
- V. The Controller shall support a MIDI input and a MIDI output interface for use in triggers and for MIDI timecode.

- W. The Controller shall support multiple remote devices connected via Ethernet for support of additional show control interfaces, such as contact closures, analogue inputs, relay outputs, serial, audio input, linear timecode, MIDI and DALI.
- X. The Controller shall support multiple remote button panel stations via Ethernet for use as triggers and for user feedback.
- Y. The Controller shall support multiple streams of linear timecode and audio data within a single networked system.
- Z. The Controller shall have a recessed switch for resetting the unit without removal of power.
- AA. The Controller shall have an internal watchdog feature that will restart the unit in the event of program failure.
- BB. Multiple Controllers shall automatically synchronize and share triggers when programmed as part of a single show and linked via Ethernet during playback.
- CC. The Controller shall support conditional logic and execute user-defined Lua scripts to support advanced show control operations.
- DD. The Controller shall be provided with a 5 year manufacturer warranty.

2.11 DMX LIGHTING CONTROLLER – PHYSICAL CHARACTERISTICS

- A. Enclosure and mounting shall comply with DIN43880 and EN60715(35/7.5) respectively
- B. The unit shall be an 8 unit DIN enclosure (143.5mm x 90.0mm x 58.0mm)
- C. The unit shall be entirely solid-state with no moving parts, fans nor hard disc drives
- D. The unit shall operate in a temperature range from 0°C to 50°C (32°F to 122°F)
- E. The unit shall be CE compliant.
- F. The unit shall be ETL/cETL listed.

2.12 DMX LIGHTING CONTROLLER – ELECTRICAL CHARACTERISTICS

- A. 3-pin 9V to 48V DC Power
- B. 3-pin isolated DMX512 Out, RDM-compatible (2)
- C. 16-pin digital/analogue inputs (8 inputs, tri-mode for digital: active high, active low or contact closure)
- D. 3-pin RS232/RS485 serial input/output
- E. RJ45 socket for 10/100Base-TX Ethernet
- F. USB-B Socket for USB 1.1
- G. 5-pin DIN socket for MIDI In
- H. 5-pin DIN socket for MIDI Out
- I. The Controller shall be able to receive power over Ethernet as an alternative to direct DC power (IEEE 802.3af PoE powered device).

2.13 DMX LIGHTING CONTROLLER - SOFTWARE

- A. The Controller shall be supported by programming software running on either a PC or Mac platform. Programming features shall include items “B” through “P” below.
- B. Comprehensive architectural and automated fixture library
- C. Drag and drop placement of fixtures on plan
- D. Drag and drop patching of fixtures to output addresses
- E. Import of any media for mapping to fixture arrays
- F. Timeline-based programming and playback
- G. Extensive range of editable effect presets
- H. Drag and drop placement of effect presets and media on timeline
- I. Variety of triggering options for firing system-wide events
- J. Each trigger event may be configured to initiate one or more lighting or show control action
- K. Each trigger event may be configured to test one or more conditions before executing its actions
- L. Simulation of individual timelines, and entire project with triggers
- M. Live output from software for programming verification purposes
- N. Controller and network management tools

- O. Export TSV reports for all aspects of programming
- P. Tools for remote management of content and show programming

2.14 WIRING AND RACEWAYS

1. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.
2. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand 150% current overload for at least three seconds without trip-out or failure.
 - a. Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B.
 - b. Line voltage units shall be UL recognized and CSA listed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Thoroughly examine project plans for control device and equipment locations. Report discrepancies, conflicts, or omissions to Architect or Engineer for resolution before starting rough-in work.
- B. Inspect site to verify that equipment can be installed as shown. Report discrepancies, conflicts, or omissions to Engineer for resolution before starting rough-in work.
- C. Examine drawings and specifications for work of others. Report inadequate headroom or space conditions or other discrepancies to Engineer. Controls Contractor shall perform at his expense necessary changes in specified work caused by failure or neglect to report discrepancies.

3.2 PROTECTION

- A. Controls Contractor shall protect against and be liable for damage to work and to material caused by Contractor's work or employees.
- B. Controls Contractor shall be responsible for work and equipment until inspected, tested, and accepted. Protect material not immediately installed. Close open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.3 COORDINATION

- A. Site.
 1. Assist in coordinating space conditions to accommodate the work of each trade where work will be installed near or will interfere with work of other trades. If installation without coordination causes interference with work of other trades, Contractor shall correct conditions without extra charge.
 2. Coordinate and schedule work with other work in the same area and with work dependent upon other work to facilitate mutual progress.
- B. Coordination with Other Controls. Integrate with and coordinate controls and control devices furnished or installed by others as follows.
 1. Controls Contractor shall be responsible for integration of control products provided by multiple suppliers regardless of where integration is described within the contract documents.

3.4 GENERAL WORKMANSHIP

- A. Install equipment, piping, and wiring or raceway horizontally, vertically, and parallel to walls wherever possible.
- B. Provide sufficient slack and flexible connections to allow for piping and equipment vibration isolation.
- C. Install equipment in readily accessible locations as defined by National Electrical Code (NEC) Chapter 1 Article 100 Part A.
- D. Verify wiring integrity to ensure continuity and freedom from shorts and ground faults.
- E. Equipment, installation, and wiring shall comply with industry specifications and standards and local codes for performance, reliability, and compatibility.

3.5 FIELD QUALITY CONTROL

- A. Work, materials, and equipment shall comply with rules and regulations of applicable local, state, and federal codes and ordinances as identified in Section 23 09 00 (Codes and Standards).
- B. Continually monitor field installation for code compliance and workmanship quality.
- C. Contractor shall arrange for work inspection by local or state authorities having jurisdiction over the work.

3.7 WIRING

- A. Control and interlock wiring and installation shall comply with national and local electrical codes, Division 26, and manufacturer's recommendations.
- B. Low-voltage wiring shall meet NEC Class 2 requirements. Subfuse low-voltage power circuits as required to meet Class 2 current limit.
- C. Install wiring in raceway where subject to mechanical damage and at levels below 3 m (10ft) in mechanical, electrical, or service rooms.
- D. Install Class 1 and Class 2 wiring in separate raceways. Boxes and panels containing high-voltage wiring and equipment shall not be used for low-voltage wiring except for the purpose of interfacing the two through relays and transformers.
- E. Do not install wiring in raceway containing tubing.
- F. Secure raceways with raceway clamps fastened to structure and spaced according to code requirements. Raceways and pull boxes shall not be hung on or attached to ductwork, electrical raceways, piping, or ceiling suspension systems.
- G. Size raceway and select wire size and type in accordance with manufacturer's recommendations and NEC requirements.
- H. Use color-coded conductors throughout.
- I. Locate control and status relays in designated enclosures only. Do not install control and status relays in packaged equipment control panel enclosures containing Class 1 starters.
- J. Conceal raceways except within mechanical, electrical, or service rooms. Maintain minimum clearance of 15 cm (6 in.) between raceway and high-temperature equipment such as steam pipes or flues.
- K. Adhere to requirements in Division 26 where raceway crosses building expansion joints. Terminate control and interlock wiring related to the work of this section. Maintain at the job site updated (as-built) wiring diagrams that identify terminations.
- L. Flexible metal raceways and liquid-tight flexible metal raceways shall not exceed 1 m (3 ft) in length and shall be supported at each end. Do not use flexible metal raceway less than ½ in. electrical trade size. Use liquid-tight flexible metal raceways in areas exposed to moisture including chiller and boiler rooms.
- M. Install raceway rigidly, support adequately, ream at both ends, and leave clean and free of obstructions. Join raceway sections with couplings and according to code. Make terminations in boxes with fittings. Make terminations not in boxes with bushings.

3.8 COMMUNICATION WIRING

- A. Communication wiring shall be low-voltage Class 2 wiring and shall comply with Article 3.7 (Wiring).
- B. Install communication wiring in separate raceways and enclosures from other Class 2 wiring.
- C. During installation do not exceed maximum cable pulling, tension, or bend radius specified by the cable manufacturer.
- D. Verify entire network's integrity following cable installation using appropriate tests for each cable.

- E. Install lightning arrestor according to manufacturer's recommendations between cable and ground where a cable enters or exits a building.
- F. Each run of communication wiring shall be a continuous length without splices when that length is commercially available. Runs longer than commercially available lengths shall have as few splices as possible using commercially available lengths.
- G. Label communication wiring to indicate origination and destination.
- H. Ground coaxial cable according to NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."

3.9 CONTROL SYSTEM CHECKOUT AND TESTING

- A. Startup Testing. Complete startup testing to verify operational control system before notifying Owner of system demonstration. Provide Owner with schedule for startup testing. Owner may have representative present during any or all startup testing.
 - 1. Verify that control wiring is properly connected and free of shorts and ground faults. Verify that terminations are tight.
 - 2. Enable control systems and verify each input device's calibration. Calibrate each device according to manufacturer's recommendations.
 - 3. Prepare a log documenting startup testing of each input and output device, with technician's initials certifying each device has been tested and calibrated.

3.12 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

- A. Demonstration. Prior to acceptance, perform the following performance tests to demonstrate system operation and compliance with specification.
 - 1. Engineer will be present to observe and review system demonstration. Notify Engineer at least 10 days before system demonstration begins.
 - 2. Demonstrate compliance with sequences of operation through each operational mode.
 - 3. Tests that fail to demonstrate proper system operation shall be repeated after Contractor makes necessary repairs or revisions to hardware or software to successfully complete each test.
- B. Acceptance.
 - 1. After tests described in this specification are performed to the satisfaction of both Engineer and Owner, Engineer will accept control system as meeting completion requirements. Engineer may exempt tests from completion requirements that cannot be performed due to circumstances beyond Contractor's control. Engineer will provide written statement of each exempted test. Exempted tests shall be performed as part of warranty.

3.13 CLEANING

- A. Each day clean up debris resulting from work. Remove packaging material as soon as its contents have been removed. Collect waste and place in designated location.
- B. On completion of work in each area, clean work debris and equipment. Keep areas free from dust, dirt, and debris.
- C. On completion of work, check equipment furnished under this section for paint damage. Repair damaged factory-finished paint to match adjacent areas. Replace deformed cabinets and enclosures with new material and repaint to match adjacent areas.

END OF SECTION 26 09 43

SECTION 26 22 00 – LOW VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. General: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Section 26 0500, apply to work specified in this section.

1.2 DRY-TYPE TRANSFORMERS

- A. General: Dry type transformers shall be factory assembled, metal enclosed, provided complete with mounting brackets as required, and installed in place.

1.3 SUBMITTALS

- A. Shop Drawings: Shop drawings shall be submitted showing dimensions, wiring diagrams, taps and nameplate nomenclature.
- B. Product Data: Product data shall be submitted showing compliance with this section of the specification, manufacturer's written recommendation for storage and protection, and installation instructions.

1.4 PRODUCT STORAGE AND HANDLING

- A. Protection: Physically protect transformers against damage as recommended by manufacturer.
- B. Storage: A waterproof covering shall be kept around all transformers until they are ready to be energized.

1.5 SUBMITTALS

- A. General: Provide shop drawings and product data on transformer showing compliance with these specifications including:
 - 1. Pad dimensions with openings required.
 - 2. Complete dimensions and drawings on transformer.
 - 3. Coolant properties.
 - 4. Incoming compartment equipment
 - 5. Accessories.

PART 2 - PRODUCTS

2.1 CONSTRUCTION - DRY TYPE TRANSFORMERS

- A. Listing: Dry type transformers shall be U.L. listed and certified to meet NEMA ST-1 with convection cooling and ST20. Transformers will be tested and rated for sound level in accordance with ASA-C89.1-1961.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Square D; Schneider Electric.
- C. Testing: Transformers shall be tested and rated for sound level in accordance with ASA-C89.1-1961.

- D. Insulation: Class H insulation shall be employed for transformers above 30 KVA with maximum temperature rise of 150 degrees C. over 40 degrees C. Class F insulation shall be employed for transformers up to and including 30 KVA with a maximum temperature rise of 115 degrees C. over 40 degrees C.
- E. Windings: Windings shall be copper. Three phase units shall be wound delta-wye. Each three phase transformer shall have three separate sets of coils. No Scott T connections, open delta, or two coil arrangements shall be permitted.
- F. Taps: Voltages shall be compatible with the application. Taps shall be provided two at plus 2-1/2 percent increments and two minus 2-1/2 percent increments from rated voltage.
- G. BIL: Minimum impulse level will be 10KV.
- H. Mounting: Transformers will be mounted where accessible. No units may be mounted behind partitions, above ceilings, etc. Each transformer will be mounted on 4 inch concrete base extending 3 inches beyond all sides.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mounting: Transformers shall be mounted where accessible. No units may be mounted behind partitions, above ceilings, etc. Each transformer shall be mounted on 3 inch concrete base extending 3 inches outside all sides.
- B. Noise Isolation: Flexible conduits shall be used to isolate noise.
- C. Grounding:
 - 1. Grounding and bonding shall be per NEC. Provide #4/0 AWG conductor run in 1 inch conduit; loop conductor from transformer to transformer and ground at main service ground.
 - 2. Provide ground to building steel and size ground per NEC 250.94.

END OF SECTION 26 22 00

SECTION 26 24 13 - SWITCHBOARDS

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. Service and distribution switchboards rated 600 V and less.
 - 2. Transient voltage suppression devices.
 - 3. Disconnecting and overcurrent protective devices.
 - 4. Instrumentation.
 - 5. Control power.
 - 6. Accessory components and features.
 - 7. Identification.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
- B. Shop Drawings: For each switchboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
 - 5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation..
 - 6. Include evidence of NRTL listing for series rating of installed devices.
 - 7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 8. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device.
 - 9. Include schematic and wiring diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Field Quality-Control Reports:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Routine maintenance requirements for switchboards and all installed components.
 - 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.6 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.
 - 1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 - 2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 - 3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 4. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 5. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 6. Indicating Lights: Equal to 10 percent of quantity installed for each size and type, but no fewer than one of each size and type.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.
- B. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- C. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- E. 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.
- F. Comply with NEMA PB 2.
- G. Comply with NFPA 70.
- H. Comply with UL 891.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

- B. Remove loose packing and flammable materials from inside switchboards and install temporary electric heating (250 W per section) to prevent condensation.
- C. Handle and prepare switchboards for installation according to NEMA PB 2.1.

1.9 PROJECT CONDITIONS

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
- B. Environmental Limitations:
 - 1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 104 deg F .
 - b. Altitude: Not exceeding 6600 feet.
- C. Service Conditions: NEMA PB 2, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet.
- D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Construction Manager and Owner no fewer than ten days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service Owner's written permission.
 - 4. Comply with NFPA 70E.

1.10 COORDINATION

- A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product by the following:
 - 1. Square D; a brand of Schneider Electric.
- B. Front-Connected, Front-Accessible Switchboards:
 - 1. Main Devices: Fixed, individually mounted.
 - 2. Branch Devices: Panel mounted.
 - 3. Sections front and rear aligned.
- C. Front- and Side-Accessible Switchboards:
 - 1. Main Devices: Fixed, individually mounted.
 - 2. Branch Devices: Panel mounted.
 - 3. Sections front and rear aligned.
- D. Front- and Rear-Accessible Switchboards:
 - 1. Main Devices and tie devices: Drawout mounted(provide where indicated on drawings)
 - 2. Branch Devices: Panel mounted.
 - 3. Sections front and rear aligned.
- E. Nominal System Voltage: As indicated on drawings.
- F. Main-Bus Continuous: As indicated on drawings
- G. Indoor Enclosures: Steel, NEMA 250, Type 1.
- H. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- I. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks.
- J. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- K. Removable Compartment Covers: Secured by captive thumb screws, for access to rear interior of switchboard.
- L. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
- M. Buses and Connections: Three phase, four wire unless otherwise indicated.
 - 1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silver-plated, with tin-plated aluminum or copper feeder circuit-breaker line connections.
 - 2. Phase- and Neutral-Bus Material: Tin-plated, high-strength, electrical-grade aluminum alloy with tin-plated aluminum circuit-breaker line connections.
 - 3. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silver-plated, or tin-plated, high-strength, electrical-grade aluminum alloy.
 - 4. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
 - 5. Ground Bus: 1/4-by-2-inch- Minimum-size required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

6. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
 7. Neutral Buses: 50 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
 8. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
 9. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
- N. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.
- O. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components including instruments and instrument transformers.

2.2 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A to 600A.
 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replaceable electronic trip; and the following field-adjustable settings for frame sizes above 600A:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response (where indicated).
 4. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at **75** percent of rated voltage where indicated.
 - e. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
 - f. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position provide where indicated.
- B. Insulated-Case Circuit Breaker (Square D Masterpact): 100 percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current. Provide for main and tie breakers:
1. Drawout circuit-breaker mounting.
 2. Two-step, stored-energy closing.
 3. Standard-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:
 - a. Instantaneous trip.

- b. Long- and short-time time adjustments.
 - c. Ground-fault pickup level, time delay, and I^2t response (where indicated)
4. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 5. Control Voltage: 120-V ac.
 6. Provide all required hardware to allow removal of circuit breakers with owner's remote racking system

2.3 INSTRUMENTATION

- A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:
 1. Potential Transformers: IEEE C57.13; 120 V, 60 Hz, single secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
 2. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; wound type; single secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
 3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
 4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.
- B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
 1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
 - a. Phase Currents, Each Phase: Plus or minus 1 percent.
 - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
 - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
 - d. Megawatts: Plus or minus 2 percent.
 - e. Megavars: Plus or minus 2 percent.
 - f. Power Factor: Plus or minus 2 percent.
 - g. Frequency: Plus or minus 0.5 percent.
 - h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
 - i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from five to 60 minutes.
 - j. Contact devices to operate remote impulse-totalizing demand meter.
 2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

2.4 CONTROL POWER

- A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.
- B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
- C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.5 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.
- C. Portable Circuit-Breaker Lifting Device: Floor-supported, roller-based, elevating carriage arranged for movement of circuit breakers in and out of compartments for present and future circuit breakers.
- D. Alternate Maintenance Setting (AMS) switch: Design for the temporary arc-flash incident energy reduction during maintenance activities.
 - 1. Provide a manual switch on the main compartment door to switch the circuit breaker short time tripping characteristics to instantaneous with minimum pick-up setting, in order to reduce the danger from potential arc-flash at downstream equipment.
 - 2. Provide a lock feature for the AMS switch so that it may be locked in either the Off or On maintenance mode position.
 - 3. Provide a blue LED indicating light to indicate AMS switch is in the maintenance mode.
 - 4. Wire contacts on all AMS switches to a common alarm input to plant control system.
 - 5. Provide for remote AMS switches or indication, as needed.
 - 6. If circuit breaker integral trip unit cannot be controlled as specified, provide discrete relay with shunt-trip or equivalent to provide specified performance.

2.6 IDENTIFICATION

- A. Presentation Media: Painted graphics in color contrasting with background color to represent bus and components, complete with lettered designations.
- B. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.
- B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
- C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install switchboards and accessories according to NEMA PB 2.1.
- B. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified in Division 03 Section Cast-in-Place Concrete
 - 1. 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 concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 4. Install anchor bolts to elevations required for proper attachment to switchboards.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
 - D. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
 - E. Install filler plates in unused spaces of panel-mounted sections.
 - F. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.
 1. Set field-adjustable switches and circuit-breaker trip ranges.
 - G. Install spare-fuse cabinet.
 - H. Comply with NECA 1.
- ### 3.3 CONNECTIONS
- A. Comply with requirements for terminating feeder bus specified in Division 26 Section "Enclosed Bus Assemblies." Drawings indicate general arrangement of bus, fittings, and specialties.
 - B. Comply with requirements for terminating cable trays specified in Division 26 Section "Cable Trays for Electrical Systems." Drawings indicate general arrangement of cable trays, fittings, and specialties.
- ### 3.4 IDENTIFICATION
- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 - B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 - C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- ### 3.5 FIELD QUALITY CONTROL
- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
 - B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
 - C. Perform tests and inspections.
 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 - D. Acceptance Testing Preparation:
 1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
 - E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Switchboard will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

3.7 PROTECTION

- A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories, and to use and reprogram microprocessor-based trip, monitoring, and communication units

END OF SECTION 26 24 13

SECTION 26 24 16 - PANELBOARDS

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. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.
 - 3. Load centers.
 - 4. Electronic-grade panelboards.

1.3 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. TVSS: Transient voltage surge suppressor.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.
 - 8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Field Quality-Control Reports:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

- C. Panelboard Schedules: For installation in panelboards.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 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.
 - 1. Keys: Two spares for each type of panelboard cabinet lock.
 - 2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Two spares for each panelboard.
 - 3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. 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.
- E. Comply with NEMA PB 1.
- F. Comply with NFPA 70.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.10 PROJECT CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is

- operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F
 - b. Altitude: Not exceeding 6600 feet
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
1. Ambient temperatures within limits specified.
 2. Altitude not exceeding 6600 feet .
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
1. Notify Construction Manager and Owner no fewer than 10 days in advance of proposed interruption of electric service.
 2. Do not proceed with interruption of electric service without Owner's written permission.
 3. Comply with NFPA 70E.

1.11 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures: Flush- and surface-mounted cabinets.
1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Wash-Down Areas: NEMA 250, Type 4X, stainless steel
 - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4
 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 3. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 4. Finishes:
 - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel
 - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

- 5. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
- B. Incoming Mains Location: Top or bottom.
- C. Phase, Neutral, and Ground Buses:
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
 - 3. Extra-Capacity Neutral Bus: Neutral bus rated 100 percent of phase bus and UL listed as suitable for nonlinear loads.
- D. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Main and Neutral Lugs: Mechanical type.
 - 3. Ground Lugs and Bus-Configured Terminators Mechanical type.
 - 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 - 5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 - 6. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- G. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide or comparable product by one of the following:
 - 1. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 - 1. For doors more than 36 inches (high, provide two latches, keyed alike.
- D. Mains: as indicated on drawings.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide comparable product by one of the following:
 - 1. Square D; a brand of Schneider Electric.
 - 2. General Electric Company
 - 3. Cutler Hammer, Eaton Corporation
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- F. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide product by the following:
 - 1. Square D; a brand of Schneider Electric.
 - 2. General Electric Company
 - 3. Cutler Hammer, Eaton Corporation
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A to 600 A.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings for frame sizes above 600A:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response(Where indicated).
 - 4. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Shunt Trip: 120V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage where indicated.

- f. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
- g. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position where indicated.
- h. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Equipment Mounting: Install panelboards on concrete bases, 4-inch nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
 - 2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to panelboards.
 - 5. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- D. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- E. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- F. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- G. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- H. Install filler plates in unused spaces.
- I. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- J. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

- K. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

- B. Set field-adjustable circuit-breaker trip ranges as indicated.

3.6 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 26 24 16

SECTION 26 24 19 – MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. General: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work specified of this section.

1.2 QUALITY ASSURANCE

- A. Compliance: Materials shall comply with the latest edition of the following standards as they apply to the different motor control types.
- B. ANSI: The latest edition of the Reference Standards for the American National Standards Institute shall apply as follows;
 - 1. ANSI Y32.2, Graphic Symbols for Electrical and Electronic Diagrams.
 - 2. ANSI Z55.1 (R1973) Gray finishes for Industrial Apparatus and Equipment.
- C. NEMA: National Electrical Manufacturers Association shall apply as follows:
 - 1. NEMA ICS-1, 2, 3, 4, 5, 6, controls and systems.
- D. NFPA: The latest adopted edition of the National Fire Protection Association shall apply as follows:
 - 1. NFPA 70, National Electric Code (NEC).
- E. UL: The latest edition of the Underwriters' Laboratories, Incorporated shall apply as follows:
 - 1. UL Electrical Construction Materials List, motor controllers.

1.3 INSTALLATION OF MOTOR CONTROL EQUIPMENT

- A. Responsibility: Unless specifically noted otherwise, motor controllers for all equipment requiring them shall be installed as part of this Division in conformance with other Sections of the specifications. Mechanical equipment, which has packaged starters, shall have controllers supplied with the mechanical equipment.
- B. Manufacturer: All starters shall be of the same manufacturer: Square "D".

1.4 DESCRIPTION OF SYSTEM

- A. Description: Motor controllers shall be factory-assembled, metal-enclosed motor control units for distribution and control of power from incoming line terminals to outgoing feeder terminals, installed and tested in place.
- B. Provisions: Motor Controllers shall include all protective devices and equipment as listed on drawings or as included in these specifications, with necessary interconnections, instrumentation, and control wiring.

1.5 SUBMITTALS

- A. Products: Submit manufacturer's product data, including technical information on each type of motor control as follows;
1. Individually mounted AC Magnetic Starters: Shop Drawings shall clearly indicate:
 - a. Frame sizes and Interrupting Capacity of starter and/or disconnect unit.
 - b. Horsepower rating at rated voltage of starter and/or disconnect unit.
 - c. Electrical ratings.
 - d. Single line diagram for power and control connections with numbered terminals and all required accessories.
 - e. All required accessories.
 - f. Manufacturer's written recommendation for storage and protection, installation instructions and field test requirements.
- B. Test Reports: Provide reports of all production and field tests. Tests shall include rated continuous and short circuit currents, dielectric, grounding, operation and control.
- C. Operations and Maintenance Data: Provide manufacturer's instructions for tightening bus connections, performing cleaning, and operating and maintaining motor control unit.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Accessories: Controllers shall be equipped with auxiliary contacts, as required for proper control functions, minimum of two normally open auxiliary contacts, in addition to the normally open auxiliary seal-in interlock and shall be suitable for the addition of at least two additional external electrical interlocks, one normally open and one normally closed. All starters shall have green "run" and red "off" pilot lights, "Hand-Off-Auto" selector switch, and nameplate. Control voltage shall be as required. Starters shall contain fused control transformers to provide correct control voltage.
- B. Power Monitor: For 3-phase motors 5hp and above, controller shall include three-phase power monitor equal to Time Mark Corporation (Model #A258B, for 480V, 3 phase systems) (Model #258B for 208V/240V, 3 phase systems) providing solid-state protection by opening starter for loss of any phase, low voltage of any or all phases, and phase reversal. Monitor shall be field adjustable for drop-out voltage of (340-480 VAC) (160-240 VAC). Provide monitor with auto-reset.
- C. Doors and Interlocks: Controller doors shall be interlocked mechanically with the unit disconnect device to prevent unintentional opening of the door while energized and unintentional application of power when door is open. Means shall be provided for releasing the interlock for intentional access to the interior at any time and intentional application of power, if desired, while door is open. Padlocking arrangements shall permit locking the disconnect device OFF with at least three padlocks with door closed or open. Unit disconnect operating handle shall be mounted on the disconnect, not on the unit door and shall indicate ON and OFF with door open or closed. Overload relays shall be reset from outside the enclosure by means of an insulated bar or button. Auxiliary switch shall be included with the disconnect switch to disconnect control circuit when the disconnect is opened.
- D. Controller Ratings: Controllers shall be rated in accordance with NEMA sizes and horsepower ratings. All controllers shall be gravity dropout. All controllers size 5 and smaller shall have double break silver alloy contacts; starters size 6 and larger shall employ single break contacts. All contacts must be capable of being inspected, and must be removable, without removing line or load wiring. Coils on starters, size 5 and smaller, shall be molded construction. On size 6 and larger, coils may be form wound, taped, varnished and baked.
- E. Control Voltage: Each controller shall contain fused control transformer to provide correct control voltage. Control voltage shall be as required. Furnish control transformers as required.

- F. Internal Control Wiring: Each control wiring conductor shall have heat shrink identification labels on each end of termination. Terminations shall be made to screw terminal strips. All points of terminal strips are to be labeled to match conductor labeling.
- G. Withstand ratings: Complete controller assembly shall have rating equal to or greater than available fault current, but in no case less than 35,000 amperes for 3-cycles.

2.2 ACROSS-THE-LINE MAGNETIC CONTROLLERS

- A. Combination Starter and Disconnect: Combination starters and disconnect switches shall be a combination across-the-line magnetic type starter with motor short-circuit protector (magnetic only breaker) disconnect, rated in accordance with NEMA Standards, sizes and horsepower rating. Final magnetic setting of MCP shall be field set and recorded. Unit shall be mounted on NEMA I enclosures, unless otherwise noted.
- B. Individual Starter Without Disconnect: Individually mounted starters shall be across-the-line magnetic type rated in accordance with NEMA Standards, sizes, and horsepower ratings. Unit shall be mounted on NEMA I enclosure, unless otherwise noted.
- C. General: Starters shall be equipped with double break silver alloy contacts. All contacts shall be replaceable from front without removing starter from enclosure. Overload relays shall be provided in each phase, and shall be alloy or bimetallic type. Thermal units shall be of the one-piece construction and interchangeable.

2.3 REVERSING MAGNETIC CONTROLLERS

- A. General: Reversing starters shall consist of two (2) contactors and a single overload relay assembled together. The contactors shall be mechanically and electrically interlocked to prevent line shorts and the energizing of both contactors simultaneously.
- B. Contacts: Magnetic starters through NEMA Size 8 shall be equipped with double-break silver alloy contacts. The starter must have straight-through wiring.
- C. Construction and Identification: Coils shall be of molded construction through NEMA Size 8. All coils to be color-coded through size 5 and permanently marked with voltage, frequency and part number.
- D. Overload Relays: Overload relays shall be an ambient compensated bimetallic-type with interchangeable heater packs. Overload to have +/- 24% adjustability, single-phase sensitivity, and isolated alarm contact and manual or automatic reset.
- E. Auxiliary Contacts: NEMA Size 00 through 2 starters shall be suitable for the addition of at least six external auxiliary contacts of any arrangement normally open or normally closed. Sizes 3 through 8 starters shall be suitable for the addition of up to eight (8) external auxiliary contacts of any arrangement normally open or normally closed.

2.4 TWO-SPEED MAGNETIC CONTROLLERS

- A. General: For 2-speed controllers, provide an adjustable electrically driven or solid-state timer (pneumatic not acceptable). Timer shall be adjustable in 1-second increments from 0 to 240 seconds and shall be wired between "high" and "low" speed. Provide 160 seconds delay unless otherwise directed.
- B. Contacts: Magnetic starters through NEMA Size 6 shall be equipped with double-break silver alloy contacts. The starter must have straight-through wiring.
- C. Construction: Coils shall be of molded construction through NEMA Size 6. All coils to be color-coded through size 5 and permanently marked with voltage, frequency and part number.

- D. Overload Relays: Overload relays shall be an ambient compensated bimetallic-type with interchangeable heater packs. Overload to have +/- 24% adjustability, single-phase sensitivity, and isolated alarm contact and manual or automatic reset.
- E. Auxiliary Contacts: NEMA Size 00 through 2 starters shall be suitable for the addition of at least six (6) external auxiliary contacts of any combination of normally open or normally closed contacts. Sizes 3 through 6 starters shall be suitable for the addition of up to eight (8) external auxiliary contacts of any combination of normally open or normally closed contacts.

2.5 REDUCED VOLTAGE MAGNETIC CONTROLLERS

- A. Part-Winding Type: First 3-pole contactor shall connect only first half-winding of motor for reduced inrush current on starting, second 3-pole contactor shall connect second half-winding of motor for running. Provide (2) 3-pole overload relays for starting and running protection. Provide electrically operated relay for adjustable start-to-run transfer timing.
- B. Wye-delta type: First 3-pole contactor shall short motor leads during starting to connect motor in wye. Second contactor energizes motor leads for wye and delta connections. Third contactor shall connect resistors in series with motor windings during start-to-run transition period. Fourth contactor shall energize motor leads during running to connect motor in delta.
- C. Autotransformer type: Contactor shall connect motor to autotransformer for starting; second contactor bypasses autotransformer and connects motor for full-voltage running.

2.6 SOLID-STATE REDUCED-VOLTAGE MOTOR CONTROLLER

- A. General: For motors 25 hp and above, or where specified, provide starters of 3-phase combination solid-state soft start/stop starter. The solid-state reduced-voltage motor controller shall consist of a power section, a one-piece printed circuit logic board and a field wiring interface terminal board.
- B. Power: The power section shall be three-phase, 60 hertz, and rated for the hp, current and voltage as shown on the drawings. It shall consist of three (3) sets of back-to-back phase controlled power semi-conductors. Maximum current limit shall be 500% for standard units.
- C. SCRs: Resistor/capacitor snubber networks shall be used to prevent false firing of SCRs due to dv/dt effects.
- D. Fan Cooled Units: Fan-cooled units shall be supplied with thermal sensors on the heat sink to trip the control protective logic for over-temperature condition. Thermal sensors shall be rated 90 degree C maximum.
- E. Logic Board: The one-piece logic board shall be mounted for easy testing, service and replacement. The logic board shall use quick disconnect plug-in connectors for current transformer inputs, line-and-load voltage inputs, SCR gate firing output circuits and status panel. The logic board soldering shall be treated with a conformal protective coating system.
- F. Controllers: Controllers shall be provided with three-phase current sensing via current transformers for closed loop control to insure motor stability shall be provided.
- G. The logic circuitry shall include as a minimum:
 1. Short-circuit electronic trip overcurrent protection. Time not to exceed 1/2 cycle
 2. Inverse time running overcurrent protection
 3. Auxiliary trip circuitry
 4. Gate firing circuit lockout protection on trip
 5. Fault relay lockout protection
 6. 250% to 500% current limit adjustment
 7. Minimum and maximum voltage adjustments
 8. Voltage stability adjustment.

- H. The logic board shall include, as standard, current and motor slip sensing circuitry that continually monitor motor load and regulate motor voltage to minimize motor kWh energy consumption. The solid-state logic shall provide phase sequence protection.
- I. External interface circuitry shall include 120-volt relay logic interface capability.
- J. Tripped functions shall be designed to be cleared by removing power from the solid-state logic board.
- K. Additional Features: The starter shall have additional features as follows:
 - 1. Individual light emitting diodes (LEDs) to indicate run, undervoltage, phase loss, phase current unbalance, overcurrent trip, overtemperature, current limit, end of ramp, and incorrect phase rotation
 - 2. Single-phase protection with built-in short time delay
 - 3. Undervoltage protection with built-in short time delay
 - 4. The power section shall have metal oxide varistor (MOV) type surge suppressors across the SCRs rated 10% above the rated voltage. The power semi-conductors shall be rated with peak inverse voltage at least 2.5 times SCR rated line-to-line voltage. Suitably rated snubbers for voltage suppression shall be included.
 - 5. 100% to 120% full load running current trip adjustment
 - 6. 200% to 500% current limit adjustment.
- L. Service: The manufacturer of the solid-state starter shall employ a field-based factory service organization for the purpose of start-up and repair of units. Third party service contractors are not acceptable.
- M. Continuous Operation: Maximum continuous operation shall be at 120% continuous amp rating.

2.7 ENCLOSURES

- A. Two (2) ground lugs shall be furnished, one (1) for incoming and one (1) for outgoing ground connections.
- B. Power terminations shall consist of pressure-type terminals for top or bottom entrance.
- C. Nema Rating: Unit shall be supplied as NEMA 1 enclosed, unless otherwise noted. All enclosures mounted outdoors shall be NEMA Type 4R or as noted NEMA Type 4X, stainless steel.
- D. Gauge: Enclosures shall not be less than 16-gauge steel. Type 12 enclosures shall be of welded construction with gasketed heat sink and doors.
- E. Operating Handle: The operating handle of the disconnect, when supplied, shall always remain connected to the breaker or switch. The operating handle shall not be mounted on the door of the enclosure, but on the controller for safe "stand-aside" operation. The position of the operating handle will indicate ON or OFF position of switch or circuit breaker and include provision for padlocking in the OFF position.
- F. Door Interlock: Interlock provisions shall prevent unauthorized opening or closing of the starter door with the disconnect in the ON position.
- G. Lifting Means: The structure, when floor-mounted, shall be provided with adequate lifting means and shall be capable of being rolled or lifted into installation position and bolted to the floor.
- H. Status Panel: A door-mounted status panel shall provide individual light emitting diodes (LEDs) to indicate run, undervoltage, phase loss, phase current unbalance, overcurrent trip, over-temperature, current limit, end of ramp, and incorrect phase rotation.

- I. Devices in Motor Control Centers: Units enclosed in motor control centers shall be of the same manufacturer as that of the circuit breaker and motor control center for coordination and design issues.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Coordination: Examine area to receive motor-control units to assure adequate clearance for motor control unit installation.
- B. Provision: Start work only after unsatisfactory conditions are corrected.

3.2 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Storage: Do not store indoor motor control units exposed to weather.
- B. Protection: Physically protect motor control units against damage from work of other trades. Cover motor control units with suitable material to avoid damage to finish.

3.3 INSTALLATION

- A. General: Provide motor control units in accordance with manufacturer's written instructions, and the NEC.

3.4 FIELD QUALITY ASSURANCE

- A. Testing: Perform tests according to motor control unit manufacturer's instructions. Field tests prior to energizing as follows;
 - 1. Megger check of phase to phase to ground insulation levels.
 - 2. Continuity.
 - 3. Short Circuit.

3.5 ADJUSTMENT AND CLEANING

- A. General: Adjust operating mechanisms for free mechanical movement.
- B. Connections: Tighten bus connections and mechanical fasteners.
- C. Finish: Touch-up scratched or marred surfaces to match original finish.

3.6 CHECK-OUT MEMO

- A. General: Submit check-out memo from motor controller manufacturer's representative.

END OF SECTION 26 24 19

SECTION 26 24 20 – SAFETY SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. General: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work specified of this section.

1.2 QUALITY ASSURANCE

- A. General: Switches and all components shall be manufactured and tested in accordance with the latest applicable standards of NEMA and UL.

1.3 SUBMITTALS

- A. Shop drawings: Product data shall be submitted on:
 - 1. Switch rating, including voltage, continuous current, short-circuit.
 - 2. Fuse ratings, when applicable.
 - 3. Cable terminal sizes.
 - 4. Enclosure type.
 - 5. Conduit entry/exit locations.

PART 2 - PRODUCTS

2.1 HEAVY DUTY SAFETY SWITCHES

- A. General: All disconnect switches shall be heavy-duty type, unless specifically noted otherwise. Switches shall be fusible or non-fusible and sized as noted on the drawings. Provide units manufactured by Square D.
- B. Switches shall be 240 volt rated on systems up to and including 120/240V and 600V rated on higher voltage systems. All switches serving motor loads or 600V rated shall be horsepower rated.
- C. Provide NEMA 1 enclosure, unless otherwise noted. All switches mounted outdoors shall be NEMA Type 3R or as noted NEMA Type 4X, stainless steel.
- D. Provide lugs on disconnect switch as required to accept conductors called for on drawings.
- E. Provide switches with an externally operated handle; quick make quick break mechanism; the handle shall be interlocked with the switch cover by means of a defeatable interlock device. The switch shall be lockable in the "off" position with a padlock.
- F. Switches shall have arc suppressors and pin hinges. Switch blades shall be readily visible in the OFF position. Switch blades and jaws shall be plated copper. Provide with line side terminal shields.

2.2 FUSES

- A. General: 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.
- B. Current Limiting: All fuses shall be current-limiting with 200,000 amperes interrupting capacity.

- C. 601 Amps and Above: 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.
- D. 600 Amps and Below: Fuses rated 600 amperes or less, installed ahead of circuit breakers or circuit breaker panels, shall be UL Class K-1. Fuses rated 600 amperes or less for all general power circuits shall be dual-element, UL Class K-5 time-delay type. They shall be self protecting from extraneous heat.
- E. Motor Circuits: Fuses installed in individual motor circuits shall be dual element time-delay type, UL Class K-5. Use fuse reducers when fuse clip spacing is larger than the fuse dimension.
- F. Rejection Fuses: Fuses called for to be rejection type are to have rejection fuse holders.
- G. Spare Fuses: Ten percent or minimum of three, whichever is greater, of each size and type of fuse, including control power or control transformer fuses, shall be placed in a spare fuse cabinet, wall mounted near the electric service.
- H. Spare Fuse Cabinet: Cabinet shall be sized as required to store all fuses neatly. Cabinet shall contain shelves and/or slots as required to separate types of fuses. Cabinet door shall be hinged with latch.
- I. Identification Label: A fuse identification label, showing type and size, shall be placed inside the door of each fused switch. Labeling for rejection type fused switches shall read "Warning-Use Only Current Limiting Fuses Class ___, Type ___, MFR ___, " engraved in red laminated plastic.

PART 3 - EXECUTION

3.1 INSPECTION

- A. General: Examine area to receive safety switch and assure that there is adequate clearances to meet NEC requirements and normal maintenance issues.
- B. Correction: Start work only after any unsatisfactory conditions has been corrected.

3.2 INSTALLATION

- A. General: Provide safety switches in complete accordance with manufacturer's written instructions and all applicable codes.
- B. Support: Switches shall be rigidly supported and installed per manufacturers recommended supporting instructions. Switches shall not be directly mounted to masonry walls; Use Kindorf, Uni-strut or similar support.
- C. Storage and Delivery: Safety switches shall be delivered to the site during that phase of installation in order to avoid storing switches on site where damage may occur. Replace any damaged parts prior to energizing. Cover to avoid damage to finish.
- D. Operations and Maintenance Data: Manufacturer's instructions for tightening connections, cleaning, operation and maintenance.

3.3 ADJUSTMENT AND CLEANING

- A. General: Adjust operating mechanisms for free mechanical movement.
- B. Connections: Tighten lug connections and mechanical fasteners.
- C. Finish: Touch-up scratched or marred surfaces to match original finish.

END OF SECTION 26 24 20

SECTION 26 27 26 – WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. General: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to this section.

1.2 DESCRIPTION

- A. General: Provide factory fabricated wiring devices in type, color and electrical rating for the service indicated to provide convenient access to the electrical system for portable and permanent connections, and control of fixed outlets.
- B. Ratings: Voltage and ampere rating of switches and receptacles shall be marked on the device, and shall conform to Voltage and Ampacity of system to which applied.
- C. Hardware: Devices consist of all the necessary hardware to complete an installation and provide a margin of safety by inaccessibility of live electrical components.
- D. Dimming Controls Quality Assurance:
 - 1. Manufacturers: Firms regularly engaged in manufacture of wiring devices, of types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years. Fully test all dimmers for proper operation prior to shipment from the factory.
 - 2. Installer: A firm with at least 5 years of successful installation experience on projects with electrical installation work similar to that required for the project.
 - 3. Warranty: Provide a minimum one-year warranty from time of installation acceptance.
- E. All dimming controls shall be compatible with the building control system unless specifically noted on plans.

1.3 RECEPTACLES AND SWITCHES QUALITY ASSURANCE

- A. Manufacturers: Manufacturers shall be companies regularly engaged in manufacture of wiring devices, of types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical installation work similar to that required for the project.
- C. Compliance: Comply with the latest edition of the following standards;
 - 1. NEMA WD1, WD3 and WD5
 - 2. UL 5, 20 and 231
 - 3. ANSI/IEEE Standard C62.41-1980 (Formerly IEEE 587)
 - a. Test withstand voltage surges of up to 6000 volts and current surges of up to 200 amperes without damage.
- D. Warranty: Provide a minimum one-year warranty from time of final acceptance.

1.4 SUBMITTALS

- A. Wiring Devices: Submit manufacturer's product data on all wiring devices listed on the drawings including;
 - 1. Colors
 - 2. Dimensions
 - 3. U.L. Label
 - 4. Finish
 - 5. Voltage
 - 6. Wiring diagrams
 - 7. Application information
- B. Coverplates and Identification: Submit type of identification used for coverplates to comply with the Identification Section as specified herein. Screws to match coverplate color.

1.5 SEQUENCING AND SCHEDULING

- A. Coordination: Coordinate with other work including wires/cables, electrical boxes and fittings, and raceways, to properly interface installation of all wiring devices.

PART 2 - PRODUCTS

2.1 CONVENIENCE RECEPTACLES

- A. Twenty Ampere Receptacles - Public: Provide hospital grade single or duplex receptacles, 2-pole, 3-wire grounding, with green hexagonal equipment ground screw, ground terminals and poles internally connected to mounting yoke, 20 ampere, 120 volts, with metal plaster ears, side wiring, NEMA configuration 5-20R unless otherwise indicated. Maximum spacing shall be 25' in public areas. (Housekeeping areas, corridors, public areas, etc)
- B. Twenty Ampere Receptacles – Back of House: Provide premium specification grade single or duplex receptacles, 2-pole, 3-wire grounding, with green hexagonal equipment ground screw, ground terminals and poles internally connected to mounting yoke, 20 ampere, 120 volts, with metal plaster ears, side wiring, NEMA configuration 5-20R unless otherwise indicated. (Storage rooms, mechanical rooms, electrical rooms, etc)
- C. Color: Devices connected to the normal system shall be grey in color, unless otherwise noted.
- D. Device Connection: All devices, switches and receptacles, will be terminated with side-wired screw terminals only. Stab-in wire connections held by spring tension are not permitted.
- E. Construction: Heavy duty nylon face and wraparound mounting strap, locked into and on the body, utilizing heavy-gauge brass ground contacts riveted to strap. Include automatic self-grounding spring to assure ground continuity between mounting strap and metal wall box. T-slot one piece copper alloy contact wipes which interface with plug blades inserted at 3 points. Line terminals shall be screw terminals and accept #14 to #10 AWG copper conductors.
- F. Ground Fault Circuit Interrupter: Provide hospital grade, duplex, ground fault circuit interrupter receptacles, grounding type, UL rated Class A, Group 1, 20 ampere ratings, 125 volts, 60 Hz; with solid state ground fault sensing and signaling; with 5 milliampere ground fault trip level; equipped with 20 ampere receptacle configuration, NEMA 5-20R. Device shall contain test and reset pushbuttons, with a visual display of the tripped position. All outside receptacles (weatherproof) shall be duplex G.F.C.I. type. Interrupter shall resist tripping from the effects of radio frequency (RF) signals from 10 to 450 MHz.

2.2 SWITCHES

- A. Toggle Switches: Provide specification grade, fast-make positive-break, flush single-pole, three and four way, silent operation toggle switches, 20 ampere, 120 volt AC or 277 volt AC as required, with mounting yoke insulated from mechanism, equipped with plaster ears, and side-wired screw terminals.
- B. Two Pole Switches: Provide two pole switches where drawings indicate the switching of 208 volt systems consisting of two phase conductors.
- C. Security Key Switches: Provide key switches where drawings indicate, where a degree of security requires limited access to control of the lighting system.
- D. Pilot Light Handle: Handle glows when switch is on. Handle color shall be clear, unless otherwise indicated.
- E. Thermal Switch: Provide fractional horsepower switch with melting alloy type overload relay, with number of poles to coordinate with the equipment being controlled. Surface or flush mounted cover, as required, equipped with padlocking device and pilot light. Provide overload relay heaters for each pole of the switch, sized per the manufacturer's instruction, and adjust heater size to permit normal operation of the motor.
- F. Color: Provide red switches for emergency circuits. Match receptacle devices for normal circuits.
- G. Manufacturer: Manufacturer shall be Pass & Seymour, Leviton or Hubbell

2.3 PLUGS AND CONNECTORS

- A. Standard: Comply with NEMA Standards Pub. No. WD1.

2.4 WIRING DEVICE ACCESSORIES

- A. Multigang: Provide all necessary hardware and frames to properly mount various devices in combinations.
- B. Weatherproof Device Covers: For all receptacles installed outdoors and/or in wet locations, provide a weatherproof enclosure in full compliance with NEC Article 406.8B. Enclosure shall be weatherproof, whether or not the attachment plug cap is inserted. The use of "flapper-type" covers is not permitted.
- C. Color: Unless otherwise noted, provide colored faceplates to match devices listed elsewhere in these specifications.
- D. Faceplates: Shall be stainless steel.

2.1 OCCUPANCY SENSORS

- A. Wall-Switch Sensors:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 6111 for 120 V, 6117 for 277 V.
 - b. Hubbell; WS1277.
 - c. Leviton; ODS 10-ID.
 - d. Pass & Seymour; WS3000.
 - e. Watt Stopper (The); WS-200.
 - 2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft..
- B. Wall-Switch Sensors:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; AT120 for 120 V, AT277 for 277 V.
 - b. Leviton; ODS 15-ID.
 2. Description: Adaptive-technology type, 120/277 V, adjustable time delay up to 20 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft.
- C. Long-Range Wall-Switch Sensors:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATP1600WRP.
 - b. Leviton; ODWWV-IRW.
 - c. Pass & Seymour; WA1001.
 - d. Watt Stopper (The); CX-100.
 2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, with a minimum coverage area of 1200 sq. ft..
- D. Long-Range Wall-Switch Sensors:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATD1600WRP.
 - b. Leviton; ODW12-MRW.
 - c. Watt Stopper (The); DT-200.
 2. Description: Dual technology, with both passive-infrared- and ultrasonic-type sensing, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, and a minimum coverage area of 1200 sq. ft..
- E. Wide-Range Wall-Switch Sensors:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATP120HBRP.
 - b. Leviton; ODWHB-IRW.
 - c. Pass & Seymour; HS1001.
 - d. Watt Stopper (The); CX-100-3.
 2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 150-degree field of view, with a minimum coverage area of 1200 sq. ft.
- F. Exterior Occupancy Sensors:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Leviton; PS200-10.
 - b. Watt Stopper (The); EW-100-120.
 2. Description: Passive-infrared type, 120/277 V, weatherproof, adjustable time delay up to 15 minutes, 180-degree field of view, and 110-foot detection range. Minimum switch rating: 1000-W incandescent, 500-VA fluorescent.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRING DEVICES

- A. General: Provide wiring devices, in accordance with manufacturer's written instructions, applicable requirements of NEC and National Electrical Contractors Associations "Standard of Installation", and in accordance with recognized industry practices to ensure that products serve intended function.

- B. Completion: Delay installation of devices until wiring and wall finish is completed.
- C. Support: Devices shall be securely supported to box, not supported to device plate. Device shall trim out flush with front of plate. Do not support the device by loosening device mounting screws and attaching the coverplate for leveling.
- D. Adjustment: Provide receptacles and switches only in electrical boxes which are clean, free from excess building materials, debris, etc. Adjust devices to plumb when tightened, and in position to receive faceplate. Devices shall not be leveled by using the mounting screws, outlet boxes shall be flush to wall finish prevent leveling problems. Tighten devices and provide securely, so that there shall be no movement during usage.
- E. Position: Position ground pin at the top of the device in vertical application, unless otherwise noted.
- F. Wiring: Provide screw terminal connections using a single conductor only. Do not "back-stab" devices. Provide single whips for all multiple conductor connections within each box.

3.2 APPLICATION OF COVER PLATES

- A. Mounting: Provide coverplates in true vertical or horizontal alignment as applicable. Plates shall be properly secured by means of screws which have heads with finish matching the plate. Secure plates so as to maintain a snug fit against wall surfaces with no gaps.
- B. Replacement: Replace all coverplates which are warped, cracked, chipped, or whose color does not match the balance of the installation. Replace screws whose threads do not allow the drawing up tight of the coverplate to the device.

3.3 CLEANING

- A. Soiled Devices: Clean devices soiled prior to acceptance inspection, to remove all debris and foreign materials, such as paint, varnish, drywall compound, etc.
- B. Solutions: Do not use liquid cleaning solutions, etc. on the face of the devices without written direction from the Engineer/Architect.

3.4 TESTING

- A. Ground testing: Provide ground testing procedures as specified herein. Prior to energizing circuitry, test wiring devices for electrical continuity, and for short circuits.
- B. Polarity: Subsequent to energization, test wiring devices for proper polarity, and to demonstrate operations as required in this and other sections of this Specification.
- C. Recording: Record all tests as required in other sections of this specification.

END OF SECTION 26 27 26

SECTION 26 28 16 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. General: Drawings and general provisions of the contract, including general and supplementary conditions and Division 1 specification sections, apply to work specified of this section.

1.2 DESCRIPTION

- A. Description of System: Provide enclosed unit-mounted overcurrent protection devices for all wiring and equipment in accordance with the NEC, all federal, state and local codes as required and/or as shown on the drawings.
- B. Discrepancies: If there are any conflicts or discrepancies in the construction documents or should the contractor disagree with the size of or application of, an overcurrent protection device called for on the drawings, the contractor shall bring it to the attention of the Engineer immediately.
- C. Manufacturer: All breakers shall be of the same manufacturer: Square "D".

1.3 SUBMITTALS

- A. Shop Drawings and Product Data: Shop drawings shall clearly indicate:
 - 1. Frame sizes and interrupting capacity of all circuit breakers.
 - 2. Horsepower ratings of rated voltage of fused switches and/or circuit breakers.
 - 3. Size and type of fuses being furnished.
 - 4. Device is U.L. Listed, and bears the U.L. Label.
 - 5. Device complies with these specifications, drawings, and applicable standards of NEMA, IEEE, ANSI, and ASA.
 - 6. Submit coordination curves on log-log paper for all breakers.
 - 7. Enclosure type and size.

PART 2 - PRODUCTS

2.1 CIRCUIT BREAKERS

- A. General: All circuit breakers shall be molded-case, quick-make, quick-break, thermal -magnetic type, and shall be U.L. listed and rated for voltage and class of service to which applied.
- B. Multi-Pole Breakers: Double and triple pole breakers shall be of the common trip, single handle type.
- C. Fault Rating: Circuit breakers shall have a rating equal to or greater than the fault current available but in no case less than 10,000 amp interrupting capacity (AIC) at 240V and 14,000 AIC at 480V. Circuit breakers shall be fully rated for the available fault; Series rating is not allowed.
- D. Arc Fault: Arc-fault circuit interrupter device shall be provided where indicated on the drawings, and where required by NEC. Device shall be UL listed for operation required in recognizing characteristics unique to arcing, functioning to de-energize circuit when arc fault is detected.
- E. Shunt Trip: Shunt trip device shall be provided as breaker accessory, where indicated on drawings. Device shall trip breaker from remote location, via trip coil. For use with momentary or maintained push button.

- F. Ground Fault: Ground fault trip shall be provided as breaker accessory, where indicated on drawings. Device shall trip breaker electrically via ground fault sensing module.
- G. Solid State Circuit Breakers: Provide solid state circuit breakers for all breakers 400 amperes and above. Breakers shall have adjustable settings for long time pickup, long time delay, short-time pickup and short time delay.
- H. Enclosures: Provide NEMA 1 enclosure, unless otherwise noted. All breakers mounted outdoors shall be NEMA Type 3R or as noted NEMA Type 4X, stainless steel.

PART 3 - EXECUTION

3.1 INSPECTION

- A. General: Examine area to receive device and assure that there is adequate clearances to meet NEC requirements and normal maintenance issues.
- B. Correction: Start work only after any unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Provide in complete accordance with manufacturer's written instructions and all applicable codes.
- B. Support: Enclosure shall be rigidly supported and installed per manufacturers recommended supporting instructions. Panels shall not be directly mounted to masonry walls; Use Kindorf, uni-strut or similar support.
- C. Storage and Delivery: Overcurrent device shall be delivered to the site during that phase of installation in order to avoid storing device on site where damage may occur. Replace any damaged parts prior to energizing panel. Cover enclosure to avoid damage to finish.
- D. Operations and Maintenance Data: Manufacturer's instructions for tightening connections, cleaning, operation and maintenance.

3.3 TESTING

- A. Refer to section 26 0080 for requirements of testing by independent testing contractor, prior to energizing overcurrent devices.

END OF SECTION 26 28 16

SECTION 26 41 13 – LIGHTNING PROTECTION FOR STRUCTURES

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 lightning protection for structures and building site components including the APM rail system.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For air terminals and mounting accessories.
 - 1. Layout of the lightning protection system, along with details of the components to be used in the installation.
 - 2. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer and manufacturer. Include data on listing or certification by UL.
- B. Certification, signed by Contractor, that roof adhesive is approved by manufacturer of roofing material.
- C. Field quality-control reports.
- D. Comply with recommendations in NFPA 780, Annex D, "Inspection and Maintenance of Lightning Protection Systems," for maintenance of the lightning protection system.
- E. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features, including the following:
 - 1. Ground rods.
 - 2. Ground loop conductor.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Certified by UL trained and approved for installation of units required for this Project.
- B. System Certificate:
 - 1. UL Master Label.
 - 2. LPI System Certificate.
 - 3. UL Master Label Recertification.

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 780, "Definitions" Article.

1.6 COORDINATION

- A. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.
- B. Coordinate installation of air terminals attached to roof systems with roofing manufacturer and Installer.
- C. Flashings of through-roof assemblies shall comply with roofing manufacturers' specifications.

PART 2 - PRODUCTS

2.1 LIGHTNING PROTECTION SYSTEM COMPONENTS

- A. Comply with UL 96 and NFPA 780.
- B. Roof-Mounted Air Terminals: NFPA 780, Class I copper unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. ERICO International Corporation.
 - b. Harger.
 - c. Heary Bros. Lightning Protection Co. Inc.
 - d. Independent Protection Co.
 - e. Thompson Lightning Protection, Inc.
 - f. Robbins Lightning, Inc.
 - 2. Air Terminals More than 24 Inches Long: With brace attached to the terminal at not less than half the height of the terminal.
 - 3. Single-Membrane, Roof-Mounted Air Terminals: Designed specifically for single-membrane roof system materials. Comply with requirements in roofing Sections.
- C. Main and Bonding Conductors: Copper
- D. Ground Loop Conductor: The same size and type as the main conductor except tinned.
- E. Ground Rods: Copper-clad steel, sectional type 5/8 inch in diameter by 96 inches long.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lightning protection components and systems according to UL 96A and NFPA 780.
- B. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends.
- C. Conceal the following conductors:
 - 1. System conductors.
 - 2. Down conductors.
 - 3. Interior conductors.
 - 4. Conductors within normal view of exterior locations at grade within 200 feet of building.

- D. Cable Connections: Use crimped or bolted connections for all conductor splices and connections between conductors and other components. Use exothermic-welded connections in underground portions of the system.
 - E. Cable Connections: Use exothermic-welded connections for all conductor splices and connections between conductors and other components.
 - 1. Exception: In single-ply membrane roofing, exothermic-welded connections may be used only below the roof level.
 - F. Air Terminals on Single-Ply Membrane Roofing: Comply with roofing membrane and adhesive manufacturer's written instructions.
 - G. Bond extremities of vertical metal bodies exceeding 60 feet in length to lightning protection components.
 - H. Ground Loop: Install ground-level, potential equalization conductor and extend around the perimeter of structure
 - 1. Bury ground ring not less than 24 inches from building foundation.
 - 2. Bond ground terminals to the ground loop.
 - 3. Bond grounded building systems to the ground loop conductor within 12 feet of grade level.
 - I. Bond lightning protection components with intermediate-level interconnection loop conductors to grounded metal bodies of building at 60-foot intervals.
- 3.2 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS
- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- 3.3 CORROSION PROTECTION
- A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.
 - B. Use conductors with protective coatings where conditions cause deterioration or corrosion of conductors.
- 3.4 FIELD QUALITY CONTROL
- A. Notify Architect at least 48 hours in advance of inspection before concealing lightning protection components.
 - B. UL Inspection: Meet requirements to obtain a UL Master Label for system.
 - C. LPI System Inspection: Meet requirements to obtain an LPI System Certificate.

END OF SECTION 26 41 13

SECTION 26 43 13 – TRANSIENT-VOLTAGE SUPPRESSION FOR LOW-VOLTAGE ELECTRICAL POWER

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 Transient Voltage Surge Suppressors (TVSS) or Surge Protection Devices (SPD) for low-voltage power, control, and communication equipment.
- B. Related Sections include the following:
 - 1. Division 26 Section "Wiring Devices" transient voltage surge suppressors.
 - 2. Division 26 Section "Panelboards"
 - 3. Division 26 Section "Switchboards"
 - 4. Division 26 Section "Lightning Protection"

1.3 SUBMITTALS

- A. Drawings: Electrical and mechanical drawings shall be provided by the manufacturer which show unit dimensions, weights, mounting provisions, connection notes, wire size and wiring diagram.
- B. Equipment Manual: The manufacturer shall furnish an installation manual with installation notes, start-up and operating instructions for the specified system. Installation instructions shall clearly state whether the system requires an external overcurrent device to maintain the system's UL 1449 listing. SPD requiring external overcurrent devices are not acceptable.
- C. Verification that all SPD are UL tested and labeled with 20kA (In) nominal discharge rating for compliance to UL96A Lightning Protection Master Label and NFPA 780. Manufacturer shall provide UL 3rd Edition documentation as part of submittal. Products submitted will be listed on UL's website under category code VZCA. Products not listed on UL's website will not be accepted.
- D. VPR (clamping voltage) rating under UL 1449 3rd edition 6kV x 3000A testing will be a maximum of the following:
 - 1. 120Vsystem 600V (L-N)
 - 2. 277Vsystem 1200V (L-N)

1.4 STANDARDS

- A. Underwriters Laboratories 1449 - (UL 1449 3rd edition or current safety standard for surge protection devices – 2009)
- B. NEC article 285. National Electrical Code 2008 and NFPA 780 Standard for the installation of lightning protection systems. SPD shall be labeled with a minimum 100kAIC rating.
- C. UL96A - Lightning Protection Master Label
- D. IEEE (Institute of Electrical and Electronic Engineering Inc.)
 - 1. IEEE C62.41.1 and C62.41.2 – 2002
 - 2. IEEE C62.45 – 2002
 - 3. IEEE C62.33 & C62.35

- E. All manufacturers must comply with above listed standards and any additions current revisions of industry standards. All products that do not comply with current industry standards will not be accepted.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain suppression devices and accessories through one source from a single manufacturer.

1.6 PROJECT CONDITIONS

- A. Placing into Service: Do not energize or connect service entrance equipment, panelboards, control terminals, or data terminals to their sources until the surge protective devices are installed and connected.
- B. Protection modes: The SPD shall provide Line to Neutral (L-N) (Wye), Line to Ground (L-G) (Wye or Delta), Line to Line (L-L) (Delta) and Neutral to Ground (N-G) (Wye) protection.
- C. Service Conditions: Rate surge protective devices for continuous operation under the following conditions, unless otherwise indicated:
 - 1. Maximum Continuous Operating Voltage (MCOV): Not less than 115 percent of nominal system operating voltage per UL 1449 3rd.
 - 2. Operating Temperature: 30 to 120 deg F.
 - 3. Humidity: 0 to 85 percent, non-condensing.
 - 4. Altitude: Less than 20,000 feet above sea level.

1.7 COORDINATION

- A. Coordinate location of field-mounted surge suppressors to allow adequate clearances for maintenance.

1.8 WARRANTY

- A. General Warranty: 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. Manufacturer shall provide a product warranty for a period of not less than ten (10) years from date of installation. Warranty shall cover unlimited replacement of TVSS modules during the warranty period. Those firms responding to this specification shall provide proof that they have been regularly engaged in the design, manufacturing and testing of TVSS for not less than five (5) years.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. PQ Protection
- B. LEA International
- C. Advanced Protection Technologies (APT)
- D. Surge Suppression Incorporated (SSI)
- E. Square D
- F. Current Technologies

2.2 SERVICE ENTRANCE SUPPRESSORS

- A. Required surge current ratings per phase:

	≥3,000Amps	2500-1600Amps	1200-800A	600A	400-100A
Service Entrance	400kA/Modular	300kA/modular	200kA/modular	200kA/Modular	200kA/Modular
Distribution	-	-	200kA	200kA	200kA

Branch Panels	-	-	-	100kA	100kA

- B. Equipment shall be a multi-stage parallel protector. All voltages must be verified by location on drawings, online diagrams and equipment scheduled. The equipment's minimum surge current capacity shall be as shown above depending upon panel amperage.
- C. SPD shall be modular design with field replaceable modules per phase and per mode. Redundant status indicators shall be mounted on the front of the door that monitors the system protection circuitry.
- D. SPD shall contain a technology that utilizes multiple thermally protected metal oxide varistors (MOV) per mode.
- E. SPD shall be labeled as minimum with Type 1 if installed ahead of the service entrance disconnect or Type 2 if installed downstream of the service entrance disconnect (verifiable at UL.com). Every component of every mode, including N-G, shall be protected by internal thermal protection. SPDs relying upon external or supplementary installed safety overcurrent protection do not meet the intent of this specification. Units must have an In (nominal discharge) of 20kA
- F. SPD shall provide the following monitoring features and options: dry contacts, surge counter and audible alarm. Equipment shall utilize a NEMA 4 enclosure.

2.3 DISTRIBUTION PANELS

- A. Device shall meet all specification requirements in section 2.1 except as follows:
 - 1. Equipment shall be a multi-stage parallel protector. All voltage must be verified by location on drawings, one-line diagrams and equipment scheduled. The equipment's minimum surge current capacity shall be 200kA per phase (L-N plus L-G) and 100kA per mode (L-N, L-G, L-L and N-G).
 - 1. The system protection shall contain metal oxide varistors (MOV). Each MOV will be individually coordinated to pass UL 1449. The unit shall be non-modular or modular type.
 - 2. Equipment shall provide the following monitoring features: dry contacts and audible alarm. Equipment shall utilize a NEMA 4 enclosure.

2.4 BRANCH PANEL SUPPRESSORS & AUXILIARY PANEL SUPPRESSORS

- A. Device shall meet all specification requirements in section 2.1 except as follows:
- B. Equipment shall be a multi-stage parallel protector. All voltage must be verified by location on drawings, one-line diagrams and equipment scheduled. The equipment's minimum surge current capacity shall be 100kA per phase (L-N plus L-G) and 50kA per mode (L-N, L-G, L-L and N-G).
 - 1. The system protection shall contain metal oxide varistors (MOV). Each MOV will be individually coordinated to pass UL 1449. The unit shall be non-modular or modular type.
 - 2. Equipment shall provide the following monitoring features: dry contacts and audible alarm. Equipment shall utilize a NEMA 4 enclosure

PART 3 - EXECUTION

3.1 INSTALLATION OF SURGE PROTECTIVE DEVICES

- A. Review all installation information in owners manual. Verify all voltage before connections to avoid injury and damage to equipment. The specified unit shall be installed external to switchboard, distribution and panelboard as stand alone. Internal products will not be accepted.
- B. The specified service entrance/switchboard/switchgear system shall be installed with the shortest lead length possible from the power conductor(s) it is protecting, must have a grounding of 25 Ohms (NEC Article 250.56) or less and shall avoid any unnecessary or sharp bends.

- 3.2 The specified distribution and branch panelboard system shall be installed with the shortest lead length possible from the power conductor(s) it is protecting, must have a grounding of 25 Ohms (NEC Article 250.56) or less and shall avoid any unnecessary or sharp bends.
- 3.3 FIELD QUALITY CONTROL
- A. Testing: Perform the following field quality-control testing:
1. After installing surge protective devices, but before electrical circuitry has been energized, test for compliance with requirements.
 2. Complete startup checks according to manufacturer's written instructions.
- B. Manufacturers Field Service:
1. Engage a factory authorized service representative to inspect equipment installation. Report results in writing
 2. Verify that electrical wiring installation complies with manufacturer's installation requirements.

END OF SECTION 26 43 13

SECTION 26 51 10 – INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish all labor, materials, tools, equipment, and services for Exterior Lighting, as indicated, in accordance with provisions of Project Specifications.
- B. Completely coordinate with work of other trades.
- C. This Section includes light fixtures, lamps and ballasts requirements for the following:
 - 1. Interior lighting fixtures, with lamps, and ballasts:
 - a. Fluorescent
 - b. Light Emitting Diodes (LEDs)
 - 2. Exit signs
 - 3. Lighting fixture supports.
- D. Related Divisions: Refer to other Divisions for the following:
 - 1. General Requirements: Division 01
 - 2. Concrete: Division 03
 - 3. Masonry: Division 04
 - 4. Metals: Division 05
 - 5. Wood, Plastics and Composites: Division 06
 - 6. Gypsum Board: Section 09 2900
 - 7. Ceramic Tile: Section 09 3000
 - 8. Acoustical Tile Ceilings: Section 09 5123
 - 9. Acoustical Metal Pan Ceiling: Section 09 5133
 - 10. Basic Electrical Requirements: Section 26 0010
 - 11. Low Voltage Electrical Power Conductors and Cables: Section 26 0519
 - 12. Grounding and Bonding for Electrical Systems: Section 26 0526
 - 13. Network Lighting Control System: Section 26 0943
 - 14. Surge Protection for Low Voltage Electrical Power Circuits: Section 26 4313
 - 15. Exterior Lighting: Section 26 5629

1.2 DEFINITIONS

- A. BF: Ballast Factor.
- B. CCT: Correlated color temperature.
- C. CRI: Color-rendering index.
- D. LER: Luminaire efficacy rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting fixture, including ballast/driver housing if provided.

1.3 SUBMITTALS

- A. Product Data: For each luminaire and support component, arranged in order of lighting unit designation. Submit manufacturer's data on features, accessories, finishes, and the following, in reproducible form:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters. Submit dimensioned drawings of lighting fixtures.
 2. Details of luminaire attachments and accessories.
 3. Details of installation and construction.
 4. Luminaire materials
 5. Photometric Data: As requested supply complete photometric data for each fixture. Photometric reports shall be rendered by an independent testing laboratory developed according to methods of the Illuminating Engineering Society (IESNA) of North America as follows:
 - a. Luminaire description and dimensions, including ballast factor for fluorescent fixtures.
 - b. Candela distribution data, presented graphically and numerically in no more than 5 degree increments (5, 10, 15, etc.). Data developed for up and down quadrants normal, parallel and at 22.5, 45, 167.5 degrees to fixture axis if light output is asymmetric.
 - c. Zonal lumens stated numerically in 10 degree increments (5, 15, etc.) and fixture efficiency.
 - d. Luminance table with data presented numerically, showing maximum luminance of the fixture at the shielding angles. Readings should be taken both crosswise and lengthwise in the case of fluorescent fixtures or fixtures with asymmetric distribution.
 - e. Coefficients of utilization table.
 - f. Ballast UL listing, volts, lamp and line amperes, input watts and minimum lamp starting temperature.
 - g. Driver UL listing, volts, input and output wattage, drive current.
 - h. Lamp ANSI designation, initial and mean lumen output, average rated hours of lamp life and lamp mortality curve, color temperature and color rendering index.
 6. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
- B. Shop Drawings: Include scalable plans, elevations, sections, details, and attachments to other work.
1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 2. Design calculations (if requested), certified by a qualified professional engineer, indicating strength of mechanical connections.
 3. Wiring Diagrams: For power, signal, and control wiring.
 4. Warranty: Sample of special warranty.
- C. Submittals or shop drawings lacking sufficient detail to indicate clear and complete compliance with contract documents shall be rejected. Include plans, elevations, sections, details, and attachments to other work.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For luminaires, to include in emergency, operation, and maintenance manuals.
- F. Provide 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 component.
 3. Structural members to which suspension systems for lighting fixtures will be attached.
 4. Other items in finished ceiling including the following:
 - a. Air outlets and inlets
 - b. Speakers
 - c. Sprinklers
 - d. Smoke and fire detectors

- e. Occupancy sensors
 - f. Access panels
 - g. Perimeter molding
- G. Samples: Submit for review one representative sample for each or any lighting fixture required under this Contract. The samples must be actual working unit of fixtures to be supplied and shall be submitted complete with cord and plug, wired for 120 Volt operation.
- H. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.

1.4 QUALITY ASSURANCE

- A. Equipment Qualifications For Products Other Than Those Specified:
 - 1. If products other than those specified are proposed for use, furnish the name, address, and telephone numbers of at least 5 comparable installations that can prove the proposed products have performed satisfactorily for 3 years. Certify in writing that the Owners of the 5 comparable installations will allow inspection of their installation by the Owner's Representative and the Company Field Advisor.
 - a. Make arrangements with the Owners of 2 installations (Architect/Engineer) for inspection of the installations by the Architect/Engineer Representative. Also obtain the services of the Company Field Advisor for the proposed products to be present. Notify the Architect/Engineer a minimum of 3 weeks prior to the availability of the installations for the inspection, and provide at least one alternative date for each inspection.
 - b. Only references from the actual Owner or Owner's representative (Security Supervisor, Maintenance Supervisor, etc.) will be accepted. References from dealers, system installers or others, who are not the actual Owners of the proposed products, are not acceptable. Verify the accuracy of all references submitted prior to submission and certify in writing that the accuracy of the information has been confirmed.
 - 2. The product manufacturer shall have test facilities available that can demonstrate that the proposed products meet the contract requirements.
 - a. Make arrangements with the test facility for the Architect/Engineer Representative to witness test demonstrations. Also obtain the services of the Company Field Advisor for the proposed product to be present at the test facility. Notify the Architect/Engineer a minimum of 3 weeks prior to the availability of the test facility, and provide at least one alternative date for the testing.
 - 3. Provide written certification from the manufacturer that the proposed products are compatible for use with all other equipment proposed for use for this system and meet all contract requirements.
- B. All lighting fixtures shall be manufactured, furnished, and installed in compliance with all government agencies having jurisdiction. All fixtures shall bear the appropriate UL (or ETL) and IBEW identifications.
- C. Provide products of firms regularly engaged in the manufacture of interior and exterior lighting equipment of the types and ratings whose products have been in satisfactory use in similar service for not less than 5 years.
- D. Materials and equipment, as well as workmanship shall conform to the highest commercial standards and shall be as specified and/or as indicated on the drawings. Parts not specifically identified shall be made of materials most appropriate for their intended use.

- E. Luminaire 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, complying with the IESNA Lighting Measurements Testing & Calculation Guides.
- F. 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.
- G. Comply with NFPA 70, "National Electrical Safety Code".
- H. Mockups: Provide interior lighting fixtures for in situ mockups complete with power and control connections; the specific design requirements of several building conditions mandates the necessity of full scale on site mockups prior to final authorization (release) to fabricate.
 - 1. Obtain Design Architect/Engineer approval of fixtures for mockups before starting installations.
 - 2. Installation of all luminaire types subject to mockup requirements may not proceed until mockup is accepted by Architect/Engineer.
 - 3. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 4. Approved fixtures in mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
 - 5. Include as part of the bid provision complete mockups for the following fixture types:
- I. National Electrical Manufacturers Association (NEMA): Comply with applicable requirements of NEMA LE 4, "Recessed Luminaires, Ceiling Compatibility" pertaining to recessed luminaires.
- J. Manufacturers: all manufacturers listed in the lighting fixture schedule (See drawing) shall be assumed capable of supplying the listed fixtures unless clearly written exceptions are set forth in their quotations. Any such exceptions shall immediately be brought to the attention of the Design Consultant. Manufacturers not listed must comply with the following:
 - 1. Experience: Manufacturers shall have not less than five years' experience in design and manufacturing of lighting fixtures of the type and quality shown. Submission must include a list of completed projects and dated catalogue pages or drawings indicating length of experience.
 - 2. Custom luminaires: Manufacturers shall submit a prototype (pre-fabrication sample) of each fixture for review by the Lighting Designer. Prototypes shall be sufficiently detailed and operational to allow evaluation of compliance with the salient features of the specification. Preliminary design or shop drawings shall not be accepted in place of prototype samples.

1.5 INDUSTRY STANDARDS

- A. Applicability of Standards: Except where more explicit or stringent requirements are written into the Contract Documents, applicable construction industry standards have the same force and effect as if found in or copied directly into the Contract Documents. Such industry standards are made a part of the Contract Documents by reference.
 - 1. Referenced standards (standards referenced directly in the contract documents) take precedence over standards that are not referenced but generally recognized in the industry for applicability to the work.
 - 2. Unreferenced standards are not directly applicable to the work, except as a general requirement of whether the work complies with recognized construction industry standards.
- B. Publication Dates: Except as otherwise indicated, where compliance with an industry standard is required, comply with the latest standard in effect as of date of Contract Documents.

- C. Conflicting Requirements: Where compliance with two or more standards or criteria is specified, and where these standards establish different or conflicting requirements for minimum quantities or performance quality levels, the most stringent requirement will be enforced, and henceforth provided by the Contractor unless the Contract Documents specifically indicates otherwise. Refer requirements that are different, but apparently equal, and uncertainties as to which quality level is more stringent, to the Design Consultant for a decision before proceeding.

1.6 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.
- B. Each fixture shall be labeled with the appropriate circuit description to coordinate with Electrical Engineer's electrical plans.
- C. Each fixture connected to Emergency power supply shall be provided with a visible (1/4" diameter) red mark or label unless otherwise noted on the Electrical Drawings.
- D. Provide complete systems including, but not limited to: lighting fixtures, lamps, ballasts, drivers, switches, mounting, wiring, control equipment, and other necessary and indicated accessories to install lighting as indicated on Contract Drawings and as specified in this section.
- E. The fixture descriptions indicated in the Luminaire Schedule in the Construction Documents, indicate manufacturer, fixture design, appearance and performance desired.
- F. Fixture locations as indicated on the Electrical drawings are generalized and approximate. Carefully verify locations with Architectural, Structural and Civil plans and other reference data prior to installation. Check for adequacy of room and non-interference with other equipment. Bring non-standard modifications necessary to comply with the Contract Documents and construction conflicts to Design Consultant's attention before proceeding with Work.
- G. Refer to drawings for dimensions and details. Check and verify dimensions before proceeding with the Work. Clarify any discrepancies with the Design Consultant. Should it appear that the Work intended to be described, is not sufficiently detailed or explained on the drawings or in these specifications, refer to Design Consultant for further drawings or explanations.
- H. Arrange scheduling of Work to prevent Work of this section being damaged by other subsequent construction operations. Remove and replace any Work so damaged at no cost to Owner.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.
 - 1. Warranty Period for Luminaires: two (2) years from the date of Substantial Completion.
 - 2. Warranty Period for Fluorescent Ballasts: five (5) years from the date of Substantial Completion.
 - 3. Warranty period for LED luminaires inclusive of arrays, modules and drivers: five (5) years from the date of Substantial Completion. Replace all LED components/arrays and fuses that fail within 24 months from date of Substantial Completion; furnish replacement LED components/arrays that fail within the second 24 months from date of Substantial Completion.

1.8 SPARES

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: 1 for every 10 of each type and rating installed. Furnish at least one of each type.
 - 2. Glass, Acrylic and Polycarbonate Lenses, Covers, and Other Optical Parts: 1 for every 10 of each type and rating installed. Furnish at least one of each type.
 - 3. Ballasts: 1 for every 20 of each type and rating installed. Furnish at least five of each type.
 - 4. Luminaires: 1 for each 20 [5%] of each type and rating installed. Furnish at least 3 of each type.
- 1.9 SAMPLES
- A. Submit for review one representative sample for each or any lighting fixture required under this Contract.
 - B. After sample acceptance, the fixture shall be sent to the project for use as a standard. In the event the submission is rejected, the fixture will be returned to the manufacturer who shall immediately make a new submission which meets the contract requirements.
 - C. The samples must be actual working unit of fixtures to be supplied and shall be submitted complete with cord and plug, wired for 120 Volt operation.
- 1.10 DELIVERY, STORAGE & HANDLING
- A. Each fixture shall be labeled with the appropriate circuit description to coordinate with Electrical Engineer's electrical plans.
 - B. Lighting fixtures shall be wrapped for protection during delivery, storage, and handling. Wet or damp wrapping shall be removed, and disposed of, to prevent staining finish.
 - C. Deliver materials in manufacturer's original, unopened, protective packaging.
 - D. Store materials in original packaging in a manner to prevent soiling and physical damage, prior to installation.
 - E. Handle in a manner to prevent damage to finished surfaces.
 - F. Where possible, maintain protective covering until installation is complete and remove such coverings as part of final cleanup.
- 1.11 TECHNICAL & ADMINISTRATIVE REQUIREMENTS
- A. All information identified in the Contract Documents shall be considered to form a complete and integrated Specification for Lighting Fixtures.
 - B. Specifications and drawings are intended to convey the salient features, function and character of the fixtures only, and do not undertake to illustrate or set forth every item or detail necessary for the work. Minor details not usually indicated on the drawings nor specified, but that are necessary or normally required for the proper execution, completion, installation and operation of the fixtures, shall be included, the same as if they were herein specified or indicated on the drawings.
 - C. Omissions: The Owner shall not be held responsible for the omission or absence of any detail, construction feature, etc. which may be normally required in the production of the lighting fixtures. The full and complete responsibility for accurately purchasing, fabricating and installing the

lighting fixtures described herein to the fulfillment of those specifications including compliance with all regulatory bodies (i.e.: UL) shall rest solely with the Contractor.

- D. The Contractor shall be solely responsible for verifying all fixture quantities, lengths and clearances required and shall inform the Design Consultant of job conditions at variance with fixtures as specified or detailed which affect installation or location at the time bid submission is made.
- E. The Contractor shall be solely responsible for coordinating and expediting the timely procurement and delivery for all lighting equipment, lamps, ballasts and related components for the project.
- F. The Contractor shall insure that the lighting fixture manufacturer shall keep on file and make available for review by the Design Consultant complete Quality Control and Quality Assurance records for all phases of production for all lighting fixtures to be supplied under this project.

1.12 MAINTENANCE

- A. Special Tools:
 - 1. Provide two tools to remove and install each type and size of fasteners on fixtures equipped with vandal resistant fasteners.
- B. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.
 - 2. Provide a list of all LED types and modules used on Project, and manufacturers' codes.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Fluorescent Fixtures: Comply with UL 1598 and UL 57. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- B. Comply with NEMA LE 4 for recessed fixtures. All recessed fixtures to be installed in insulated ceilings shall be provided with UL listed thermocouple protection.
- C. LED Luminaires: Lighting fixtures shall conform to IES LM-79-08 and LM-80-08 standards. All fixtures shall be RoHS compliant.
- D. Lighting fixtures shall be of rigid construction, dimensionally stable, and shall be assembled with secure fastenings. Ferrous parts shall be protected from corrosion by plating or shall be finished with high reflectance enamel with non-yellowing binder and high pigment to binder ratio, with semi-gloss finish. Ferrous parts shall be prepared for finish by industry standard finishing process (see Finishes). Nonferrous metals (i.e. aluminum) unless otherwise noted be treated with a semi-gloss polyester powder coat enamel finish.
- E. Recessed, surface or pendant lighting fixtures shall be suspended from structural members or ceiling structure members of minimum 1-1/2" channels, by standard bar hangers, or other approved means. Fixture locations shall be coordinated with ceiling patterns. Refer to architectural reflected ceiling plan for exact location of fixtures and architectural rooms finish schedule for ceiling construction details and mounting heights. The installing contractor shall provide all structural steel and related supports as required or necessary to properly and safely install and support the fixtures.
- F. Fixture wiring shall be suitable for the temperature rating of the fixture; wiring through fluorescent

channels shall be done with Type SFF2 wire U.O.N by manufacturer. Where a junction box is required, to change from branch circuit to fixture wiring, use approved feed through, pre-wired fixture wiring, and install a separate junction box. The junction box shall be fully accessible after installation of covering materials. Where flexible conduit or portable cord is used, a grounding jumper shall be installed. All fixtures shall be grounded. Housings shall be so constructed that all electrical components are easily accessible and replaceable without removing fixtures from their mountings, or disassembling adjacent construction.

- G. All recessed, pendant and surface mounted lighting fixtures unless otherwise noted or directed shall be UL listed for through-wiring and shall be furnished complete with all required integral wiring and all required flexible conditions, pigtails and related accessories necessary for suitable operation and installation.
- H. All materials, accessories, and other related fixture parts shall be new and free from defects which in any manner may impair their character, appearance, strength, durability and function, and be effectively protected from any damage or injury from the time of fabrication to the time of delivery and until final written acceptance of the work by the Architect
- I. Where surface mounted junction boxes are called for, the lighting manufacturer shall provide a canopy cover which completely covers the entire junction box.
- J. Castings: All aluminum, iron or composite casting shall be exact replicas of the approved patterns and shall be free of sand pits, blemishes, scales and rust, and shall be smoothly furnished. Tolerance shall be provided for any shrinkage of the metal castings in order that the finished casting will accurately fit in their designated locations. Unless otherwise noted, for cast aluminum components use copper-free 319 or 443 aluminum alloy only. For cast iron components use ASTM Spec A48-83 Class 30 gray iron.
- K. Mounting frames and rings: if ceiling system requires, each recessed fixture shall be furnished with a mounting frame or ring compatible with the ceiling in which they are to be installed. The frames and rings shall be one piece or constructed with electrically welded butt joints and of sufficient size and strength to sustain the weight of the fixture.
- L. Yokes, brackets and supplementary supporting members needed to mount lighting fixtures to carrier channels, suitable ceiling members or other structure shall be furnished and installed by the Contractor.
- M. Provide each fixture with lamps as indicated in the lighting fixture schedule.
- N. Metal Parts: Free of burrs and sharp corners and edges. All sheet metal work shall be free from tool marks and dents.
- O. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.
- P. Housings: Rigidly formed, min. No. 20 gauge cold rolled steel weather- and light-tight enclosures that will not warp, sag, or deform in use. Refer to the Lighting Fixture Schedule for specific housing requirements and gauges.
- Q. 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.
- R. For steel and aluminum fixtures all screws, bolts, nuts and other fastening and latching hardware shall be cadmium or equivalent plated. For stainless steel fixtures, all hardware shall be stainless steel. Whenever possible all fasteners shall be captive type. Where indicated provide security head Torx

center pin tamper resistant fasteners.

- S. Welding shall be in accordance with recommendations of the American Welding Society and shall be done with electrodes and/or methods recommended by the manufacturers of the metals being welded. Welds shall be continuous, except where spot welding is specifically permitted. Welds exposed to view shall be ground flush and dressed smooth. All welds on or behind surfaces which will be exposed to view shall be done so that finished surfaces will be free of imperfections such as pits, runs, splatter, cracks, warping, dimpling, depressions or other forms of distortion or discoloration. All welded surfaces shall be free of weld splatter and welding oxides.
- T. All extruded aluminum fixtures shall be fabricated of 6063-T3 alloy (min. wall thickness .120 unless otherwise noted on the Contract Drawings) and in all cases shall be provided with heavy gauge internal alignment brackets in order to assure tight joints and a clean level and continuous appearance after installation. Unless otherwise noted, all end plates shall be continuously welded, filled and ground prior to application of final paint finishes so as to present a clean, seamless and monolithic appearance. Miter cuts shall be accurate. Joints shall be flush and without burrs. Cuts shall maintain alignment with the light fixture located in its final position.
- U. Exposed fasteners on end plates are prohibited.
- V. All fixtures with removable louvers, lenses, reflectors, refractors, cones or other shielding devices shall be supplied with integral safety chains. Contractor shall be responsible for insuring that all safety chains are securely fastened to shielding device and fixture housing.
- W. Exposed Fasteners: All fasteners at every product and assembly exposed to view or accessible with the inpatient environment shall be Security head Torx center pin tamper resistant, and stainless steel.
- X. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- Y. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
 - 1. White Surfaces: 92 percent
 - 2. Specular Surfaces: 87 percent
 - 3. Diffusing Specular Surfaces: 83 percent
- Z. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- AA. Factory-Applied Labels: Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place. Equip each fixture with a label, located conspicuously inside of fixture, which states the type of lamps required for the fixture.
- BB. Additional Components: Equip fixtures with the following additional components, as applicable:
 - 1. Additional ballasts for night light or emergency light circuits where indicated on drawings.
 - 2. Plaster frames as required for installation of recessed and semi-recessed fixtures.
 - 3. Safety clips for fixtures installed in grid ceilings.
 - 4. End caps for individually mounted fixtures and end of continuous row fixtures.
 - 5. Finishing collar or combination finishing collar/outlet box for surface mounted fixture used with exposed raceway:
 - a. Finishing Collar: Same finish and peripheral dimensions as the fixture base, including provisions for mounting, slots to fit over raceway and of depth to cover outlet box and extend back to ceiling or wall.
 - b. Combination Finishing Collar/Outlet Box: Same finish and peripheral dimensions as the fixture base, gage or thickness of metal as required by National Electrical Code,

including provisions for mounting and knockouts or threaded bosses for entrance of raceway.

2.2 FLUORESCENT LIGHTING FIXTURES

- A. General: Conform to UL 1570, except for damp and wet locations conform to UL 57.
- B. Housing end plates, socket bridges, reflectors, wiring channels and ballast covers shall be die formed of not less than No. 20 gauge (0.0359 inch thick) cold rolled steel unless specified otherwise. Construct fixtures so that ballast may be serviced or replaced without removal of fixture housing.
- C. Fluorescent lampholders shall be heavy white thermoset urea plastic with definite locking-in feature and silver-plated contacts for proper lamp operation and life. Outdoor lampholders shall be neoprene gasketed and compression type. Sockets with open circuit voltage over 300 volts shall be safety type and designed to open supply circuit on lamp removal. All fluorescent lamp holders shall be UL listed devices.
- D. Mount fluorescent lamps on series rapid-start circuits within one inch of grounded metal, minimum one inch wide, as long as lamp.
- E. Electromagnetic Interference Filters: Provide electromagnetic interference filters in fluorescent fixtures where indicated. Filters shall be integral to the fixture assembly, one filter per ballast and shall suppress electromagnetic interference as required by MIL-STD-461, "Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference."

2.3 LAMPS

- A. Unless otherwise indicated, all lamps specified shall be as manufactured by G.E. Venture, Osram/Sylvania or Philips. Substitutions of lamps by other manufacturers shall be equal in all respects of the following:
 - 1. Initial and maintained lumen output.
 - 2. Lamp life
 - 3. Correlated color temperatures (in degrees Kelvin)
 - 4. Color rendering index (CRI)
 - 5. Compatibility with specified equipment
 - 6. Manufacturers hoping to substitute lamps must verify that they have been manufacturing lamps for a minimum of (7) seven years prior their offer of substitution. Lamp substitutions shall be submitted for approval in the form of both manufacturer's printed data and corresponding samples for review.
- B. All lamps shall comply with the requirements of the Energy Policy Acts of 1992 and 2005.
- C. All lamps where applicable shall comply with ANSI C78 Series standards.
- D. Fluorescent lamps shall be of the specified wattage and lumen output as indicated in the fixture schedule. Lumen output at 33% rated life shall not be less than 80% of initial output. Contractor shall replace any lamps failing during the first two hundred (200) days of burning after Substantial Completion.
- E. Fluorescent:
 - Fluorescent lamps shall be of the specified wattage and lumen output as indicated in the fixture schedule. Lumen output at 33% rated life shall not be less than 80% of initial output. Contractor shall replace any lamps failing during the first two hundred (200) days of burning after final written acceptance by the architect/engineer:
 - 1. 4'-T8/25 watt:

Unless otherwise indicated or authorized, all linear fluorescent lamps for use on this project shall be 25 watt 4'-0" mini bi-pin base, T-8 185mA, 3500°K triphosphor type (only) as manufactured by G.E., Osram/Sylvania or Philips, with a minimum CRI of 82. Lamp shall have an average rated life (3 hours/start) of 80,000 hours, and produce at least 2,400 lumens initial.

2.4 BALLAST FOR FLUORESCENT LAMPS

- A. Ballasts shall be UL listed, type 1 outdoor and CSA certified where applicable. Ballasts shall be high power factor types, designed to operate on the voltage system to which they are connected. Ballasts shall be Class P with sound rating "A" unless otherwise noted. Fixtures and ballasts shall be designed and constructed to limit the ballast case temperature to 75° C (152° F) when installed in an ambient temperature of 40° C (96° F).
1. Ballasts shall be designed for input voltage of circuits to which they are connected. Submit for each type of fixture used in the project certification that each type of fixture has been tested, equipped and mounted as it is to be finally installed and found to operate satisfactorily and as specified. Maintain the conditions required by the manufacturer for proper operation throughout the construction period. The permanent installation shall conform to the drawings and specifications and the conditions required by the fixture manufacturer for proper operation of ballast, fixture and lamp.
 2. Ballasts shall contain no PCBs.
 3. Ballast manufacturer shall certify to have been manufacturing ballasts for no less than fifteen years prior to submission of data and shall along with their bid submit evidence of successful past installations of similar scale and scope.
- B. Fluorescent high frequency electronic ballasts for T8 Lamps:
1. Provide energy efficient, solid-state electronic ballasts. The ballasts shall be designed to operate at an input frequency of 60 Hz and shall invert the low frequency to a high frequency (20 kHz) and apply this to the lamps which shall operate without visible flicker. Ballast shall be designed to exclusively operate specify lamp type and quantity, [i.e., one-25 watt T-8 rapid start lamp]. Rapid start ballasts shall maintain lamp filament heating after the lamps are started to assure optimum lamp life.
 - a. All 185mA T-8 (25w) electronic ballasts shall be program rapid-start types [only].
 - b. Ballast shall be high frequency (20 kHz or greater) and operate without visually detectable flicker (stroboscopic effect).
 - c. Ballasts shall have high power factor/minimum 95 percent, UL listed for Class P, sound rated A, Type I outdoor.
 - d. Electronic ballast shall have a lamp current crest factor of no more than 1.7.
 - e. Harmonic Distortion: Ballast shall not generate total harmonics (THD) in excess of 10%. Upon request, tests shall be submitted demonstrating performance using specified number and type of lamps.
 - f. Ballasts shall be fully or particularly potted for heat disposition.
 - g. Ballast Factor: Electronic ballast operation shall insure that lamp lumen output is no less than the value listed below of lamp manufacturer's printed lumen output utilizing standardized core and coil ballasts.

One 25w T8	0.86
Two 25w T8	0.86
 2. Efficacy: Ballast shall meet minimum efficacy standards of Public Law No. 100-357 (1988): 2-F40T12, 1-F40T12, 2-F96T12+ HO.
 3. Ballast shall be short circuit protected.
 4. Line Transient Protection: Ballast shall be designed to withstand line transients as defined in ANSI C62.41-1991 Cat. A1.

5. Electromagnetic and RF Interference: Ballast shall comply with Part 18 of the FCC Federal Commission Rules and Regulations, Subpart C for Non-Consumer Equipment.
6. Ballast case operating temperature shall not exceed 35°C (56° F) temperature rise.
7. Ballast shall have a 3-year written warranty from date of installation, against mechanical or electrical defects under normal conditions of use. Warranty shall include free replacement for warranty period.
8. Upon request the Contractor shall submit for review by the Lighting Designer definitive independent laboratory (ETL or other) "bench" test data regarding performance of ballasts.
9. Reduced-current and hybrid electronic/magnetic ballasts are not acceptable.
 - a. Electronic ballasts shall have a Lamp Current Crest Factor of less than 1.7, in accordance with lamp manufacturer's recommendations and ANSI C82.11.
 - b. Electronic ballast shall support a sustained short to ground or open circuit of any output leads without damage to the ballast.
10. Ballast shall tolerate operation in ambient temperatures up to 40 deg C 105 deg F without damage.
 - a. Light output shall remain constant for a line voltage fluctuation of +/- 5 percent.
 - b. Ballast shall meet ANSI C62.41 Cat. A for transient protection.
11. Provide all the above conditions and specifications are met or exceeded, the following manufacturers producing solid-state electronic ballasts shall be considered acceptable.
 - a. ULT
 - b. Philips Advance
 - c. Osram/Sylvania
 - d. GE

2.5 SOLID STATE LIGHTING (LED) FIXTURES

A. General

1. All fixtures shall conform with standards prepared by CIE, IES, UL, and other standards organizations as they apply to solid state lighting technologies. Including but not limited to:
2. TC2-46 CIE/ISO standards on LED intensity measurements.
3. TC2-50 Measurements of the optical properties of LED clusters and arrays.
4. TC2-58 Measurements of LED radiance and luminance.
5. TC2-63 Optical measurement of High-Power LEDs.
6. TC2-64 High speed testing methods for LEDs.
7. Luminaire performance claims shall be measured in accordance with the requirements of IEC/PAS 62612: Edition 1: 2009-06. The testing quantity for LED package lamps shall be a minimum of (20) twenty. The drive current and bin reference should be clearly documented. All manufacturer data to include:
 - a. Luminaire efficacy should be calculated from the initial lumen output of the luminaire that has reached thermal stability operating in an ambient temperature of 25 degrees Celsius and based on the total power of the LEDs and driver circuit.
 - b. Definition of life shall comply with Clause 10 IEC/PAS 62612. Life shall be based on lumen depreciation and failure and shall consist of an endurance test. It shall be clearly noted which part of life and lumen depreciation has been measured and what part has been calculated or extrapolated.
 - c. Lumen depreciation shall be clearly document the length of time a complete LED luminaire provided more than a percentage of the rated luminous flux under standard test conditions. For illuminating luminaires the percentage shall be >80%, indicated as L80 (>80%). For direct view luminaires the percentage should be >50%, indicated as L50.
 - d. Thermal losses: The temperature of the p-n junction of the raw LED (die) (Tj) is to be measured at an ambient temperature of 25 degrees Celsius. In a luminaire the die will be operating at a higher temperature. All performance parameters are to measure the Junction Temperature and Board Temperature.

- e. Thermal protection: All fixtures shall be provided with appropriate heat sink to maintain lamp life. Stated lamp life and output shall be measured and identified and documented with heat sink. Any variations from stated life or output without heat sink shall be clearly identified including Junction Temperature.
- 8. Drivers:
 - a. Constant current Drivers [non-dimming]: All constant current drivers shall be UL 1310 class 2 including short-circuit protection, high-power factor, with either 12v or 24v input, unless otherwise noted. The driver shall operation on the voltage they are connected to, 120 or 277v input power. Variability in output shall not exceed 5% in load or 1% line levels. Driver shall be designed for use in -40 degree Celsius environments with a high temperature tolerance of +60 degrees ambient, 80 degrees Celsius case rating. Total harmonic distortions shall not exceed 20% with a current crest factor of 1.5 maximum. All drivers shall be field replaceable.
 - b. Dimming Drivers: All PWM dimming drivers shall be UL 1310 class 2 including short-circuit protection, high-power factor, with either 12v or 24v input, unless otherwise noted. The light output of the LED shall be controlled either by DC voltage applied to the control input (0-10V) with a maximum of 500 microamps per driver. The control equipment must not impose a voltage greater than 11.0V peak maximum on the driver terminals and the short-term transient voltage must not exceed 14 volts. Control equipment intended to control more than one driver must be capable of sinking the current supplied to the control bus by the maximum number of drivers specified for the control device. The control terminals for the driver shall be isolated from the power lines and suitable for use as Class II terminals. Maximum voltage drop not to exceed 0.2 volts. Variability in output shall not exceed 5% in load or 1% line levels. Driver shall be designed for use in - 40 degree Celsius environments with a high temperature tolerance of +60 degrees ambient, 80 degrees Celsius case rating. Total harmonic distortions shall not exceed 20% with a current crest factor of 1.5 maximum. All drivers shall be field replaceable.
- 9. Lamp Module: All manufacturer data to include LED module information, including but not limited to:
 - a. Manufacturer of the LED module with part number or other device identifier.
 - b. LED module drive current, voltage, power.
 - c. LED module lumen depreciation curves, life, CCT, CRI at an ambient temperature of 25 degrees Celsius.
 - d. Board temperature of the LED module installed in the luminaire with proper heat sink, when the luminaire is operating at an ambient temperature of 25 degrees Celsius.
 - e. The color bin, CCT, and color shift variation of the LED module at the operating board temperature.
 - f. Color rendering index at the operating board temperature.
 - g. LED lamp modules shall be minimum CRI of 70 with tolerances as identified in Clause 7 IEC/PAS 62612.
 - h. White LED modules shall be available in 3500K as identified in the lighting fixture schedule.

2.6 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 steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gauge.

- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gauge.
- F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

2.7 FINISHES

- A. Painted surfaces shall be synthetic enamel with acrylic, alkyd, epoxy, polyester or polyurethane base, light stabilized, baked on at 350 degrees Fahrenheit minimum, catalytically or photo-chemically polymerized after application.
- B. Optical white finishes: minimum 92% reflectance (semi-gloss).
- C. Selection: Unless otherwise indicated, all fixture finishes shall be semi-gloss polyester powder coat enamel (color to be selected by Design Consultant).
- D. Undercoat: Except for stainless steel all ferrous metal surfaces shall be given a five stage phosphate treatment or other acceptable base bonding treatment before final painting and after fabrication.
- E. Unpainted non-reflecting surfaces shall be satin finished and coated with a baked-on clear lacquer to preserve the finish. Where aluminum surfaces are treated with an anodic process, the clear lacquer coating may be omitted.
- F. Unpainted aluminum surfaces: Finish interior aluminum trims with an anodized coating of not less than 7 mg. per square inch, of a color and surface finish as selected by the Design Consultant. Finish exterior aluminum and aluminum trims with an anodized coating of not less than 35 mg. per square inch of a color and surface finish as selected by the Design Consultant.
- G. Metal finishes: Provide finishes of the color and type indicated and having the following properties:
 - 1. Protection of metal from corrosion: 5-year warranty against perforation or erosion of the finish from weathering.
 - 2. Color retention: 5-year warranty against fading, staining, or chalking from weathering including solar radiation.
 - 3. Uniformity: Provide finish of uniform thickness and color, free from streaks, stains or orange peel texture.

2.8 REFLECTORS

- A. Reflectors, cones or baffles shall be absolutely free of spinning lines, stains, ripples or any marks or indentations caused by riveting to other assembly techniques.
- B. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
- C. All fixtures with removable reflectors shall be supplied with safety chains. Where stem/mounted pendant fixtures are indicated provide a minimum of (3) three cable supports to minimize sway. Cable supports shall be stainless steel woven wire (or equivalent).
- D. Cone flanges shall be formed as an integral part of the cone and shall have identical color and finish as the cone, except as shown. The flange's major surface shall be perpendicular to the cone axis.
- E. The reflecting surface of the cone or reflector shall be tested for proper sealing. Test per ASTM B136-

63T. If any stain is visible, the specimen shall not be considered to have been properly sealed. Reflector cones shall be free of manufactured defects. The reflector inner surface shall be free of water spotting and shall maintain a reflectivity ratio of not less than 83% on clear specular finish.

- F. All Alzak parabolic cones shall be guaranteed by the manufacturer against discoloration for a minimum of ten years and in the event of premature discoloration shall be replaced by the manufacturer (including both materials and the cost of labor) at no cost to the Owner.

2.9 LENSES, LOUVERS, AND DIFFUSERS

- A. All lenses, diffusers, and shielding media shall be properly and securely mounted within fixture assemblies. All fixtures with removable reflectors, louvers or baffles shall be supplied with safety chains.
- B. All fixtures with removable louvers or other shielding devices shall be supplied with safety chains.
- C. Unless otherwise indicated, all plastic shielding, lenses and diffusers shall be 100% UV stabilized virgin acrylic or polycarbonate.

Unless otherwise indicated, all glass shielding, diffusers or lenses shall be clear tempered borosilicate glass. Glass used for lenses, refractors and diffusers in incandescent and tungsten halogen lighting fixtures shall be tempered for high impact and heat resistance. Soda Lime glass is not acceptable. Min. transmittance = 92%.

- D. Optical lenses shall be free from spherical or chromatic aberrations and other imperfections, which may hinder the functional performance of the lenses.
- E. All lenses, louvers or other light diffusing elements shall be removable but positively held so that hinging or other normal motion will not cause them to drop out. Lay-in type lenses and Louvers are not acceptable.

2.10 STEMS

- A. Each stem shall have a brass or steel swivel, hang straight, or other self-aligning device.
- B. Wherever a fixture or its hanger canopy is applied to a surface mounted outlet box a finishing ring shall be utilized to conceal the box.
- C. Unless otherwise indicated, all stems shall match in color and finish the color of the fixture which they support.
- D. Stems shall be free of clamp marks, scratches and all other visual imperfections.
- E. Unless otherwise indicated, stems shall be provided in order to adequately mount and level each fixture run with proper structural support per manufacturer's recommendations.
- F. Install pendant lighting fixtures plumb and at a height from the floor as specified on the drawings. In cases where conditions make this impractical, refer to the Design Consultant for direction. Use ball aligners and canopies on pendant fixtures unless otherwise noted.
- G. Space stems equally spaced every fixture run. If field conditions or fixture construction do not allow for this condition, the installing Contractor shall immediately notify the Design Consultant prior to commencement of the work.

2.11 MISCELLANEOUS

- A. Where (or if) indicated all remote step-down transformers, drivers and ballasts shall be properly wired to fixtures to insure that voltage drop does not exceed 5%, regardless of transformer's or ballast's location.
- B. All remote step-down transformers, drivers and ballasts shall be mounted in approved NEMA type enclosures and only located in areas previously deemed to be readily accessible by the owner's maintenance personnel.
- C. All fixture lengths whether straight or curvilinear shall be fabricated based upon the fixture manufacturer's or contractor's field verified dimensions only.
- D. Fixture manufacturer shall coordinate conduit entry locations with installing contractor.

2.12 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs
 - 1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
 - 2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - a. Battery: Sealed, maintenance-free, nickel-cadmium free.
 - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - d. Test Push Button: Push-to-test, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - f. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

PART 3 - INSTALLATION

3.1 INSTALLATION

- A. General: Install fixtures at locations indicated on the drawings. Do not scale electrical drawings for exact location of the lighting fixtures; in general, the architectural reflected ceiling plans indicate the proper locations of lighting fixtures, unless otherwise noted on architectural plans. Set level, plumb and square with ceilings and walls unless otherwise indicated. Install lamps in each luminaire. Align luminaires set in continuous rows.
- B. 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.
- C. All fixture lengths whether straight or curvilinear shall be fabricated based upon the fixture manufacturer's or contractor's field verified dimensions only.
- D. Temporary Lighting: If it is necessary, and approved by the owner/architect/engineer to use

permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

- E. Mounting: Mounting heights specified or indicated are to bottom of fixture for suspended and ceiling mounted fixtures and to center of fixture for wall mounted fixtures. Obtain approval of the exact mounting for lighting fixtures on the job before installation is commenced and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed.
 - F. Remote Mounting of Ballasts/Driver: Distance between the ballast/driver and fixture shall not exceed that recommended by ballast/driver manufacturer. Verify, with ballast/driver manufacturers, maximum distance between ballast/driver and luminaire.
 - G. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element, where permitted by Code.
 - 1. Install ceiling support system rods or wires for each fixture. Locate not more than 6 inches from lighting fixture corners.
 - 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
 - 3. 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 metal channels spanning and secured to ceiling tees.
 - 4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
 - H. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cable."
 - I. Unless otherwise shown on the Contract Drawings, lighting fixtures and/or fixture outlet boxes shall be provided with hangers to adequately support the complete weight of the lighting fixture.
 - J. Provide all hangers, rods, mounting brackets, supports, frames, earthquake clips and other equipment normally required for the proper, safe and distortion-free installation in the various surfaces in which they appear. Determine surface types from the architectural drawings.
 - K. All pendant mounted lighting fixtures within the same room or area shall be installed plumb, and at a uniform height from the finished floor. Adjustment of desired height (if required) shall be made during the installation phase. Unless otherwise shown on the Contract Drawings, stems and canopies shall be matched to the associated lighting fixtures.
 - L. Install reflector cones, baffles, aperture plates, light controlling elements for air handling fixtures and decorative elements after completion of ceiling tiles, painting and general cleanup.
 - M. Replace blemished, damaged, or unsatisfactory fixtures as directed by the Architect/Engineer Representative.
- 3.2 ADJUST AND CLEAN**
- A. Clean lighting fixtures of dirt and debris upon completion of installation.
 - B. Protect installed fixtures from damage during remainder of construction period.
 - C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work

may be required after dark:

1. Adjust aimable luminaires in the presence of Architect/Engineer.
2. As/if required, aiming shall be accomplished at night.

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. Verify that self-luminous exit signs are installed according to their listing and the requirements in NFPA 101.
- C. 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.

3.4 STARTUP SERVICE

- A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

END OF SECTION 26 51 10

SECTION 26 56 29 – EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish all labor, materials, tools, equipment, and services for Exterior Lighting, as indicated, in accordance with provisions of Project Specifications.
- B. Completely coordinate with work of other trades.
- C. This Section includes light fixtures, lamps and ballasts requirements for the following:
 - 1. Exterior lighting fixtures, with LED modules, components and drivers.
 - 2. Fixture mounting shielding & accessories.
 - 3. Lighting fixture supports.
- D. Related Divisions: Refer to other Divisions for the following:
 - 1. General Requirements: Division 01
 - 2. Concrete: Division 03
 - 3. Cast-In-Place Concrete: Section 03 3000
 - 4. Metals: Division 05
 - 5. Basic Electrical Requirements: Section 26 0010
 - 6. Low Voltage Electrical Power Conductors: Section 260519
 - 7. Grounding and Bonding for Electrical Systems: Section 260526
 - 8. Network Lighting Control System: Section 260943
 - 9. Surge Protection for Low Voltage Electrical Power Circuits: Section 264313
 - 10. Interior Lighting: Section 265110
 - 11. Earthwork: Division 31

1.2 DEFINITIONS

- A. BF: Ballast Factor.
- B. CCT: Correlated color temperature.
- C. CRI: Color-rendering index.
- D. LER: Luminaire efficacy rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.3 SUBMITTALS

- A. Product Data: For each luminaire and support component, arranged in order of lighting unit designation. Submit manufacturer's data on features, accessories, finishes, and the following, in reproducible form:
 - 1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters. Submit dimensioned drawings of lighting fixtures.
 - 2. Details of luminaire attachments and accessories.
 - 3. Details of installation and construction.

4. Luminaire materials.
 5. Photometric Data: As requested supply complete photometric data for each fixture. Photometric reports shall be rendered by an independent testing laboratory developed according to methods of the Illuminating Engineering Society (IESNA) of North America as follows:
 - a. Luminaire description and dimensions, including ballast factor for fluorescent fixtures.
 - b. Candela distribution data, presented graphically and numerically in no more than 5 degree increments (5, 10, 15, etc.). Data developed for up and down quadrants normal, parallel and at 22.5, 45, 167.5 degrees to fixture axis if light output is asymmetric. c. Zonal lumens stated numerically in 10 degree increments (5, 15, etc.) and fixture efficiency.
 - c. Luminance table with data presented numerically, showing maximum luminance of the fixture at the shielding angles. Readings should be taken both crosswise and lengthwise in the case of fluorescent fixtures or fixtures with asymmetric distribution.
 - d. Coefficients of utilization table.
 - e. Ballast UL listing, volts, lamp and line amperes, input watts and minimum lamp starting temperature.
 - f. Driver UL listing, volts, input and output wattage, drive current.
 - g. Initial and mean lumen output, average rated hours of lamp life and lamp mortality curve, color temperature and color rendering index.
 6. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
- B. Shop Drawings: Include scalable plans, elevations, sections, details, and attachments to other work.
1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 2. Design calculations (if requested), certified by a qualified professional engineer, indicating strength of mechanical connections.
 3. Wiring Diagrams: For power, signal, and control wiring.
 4. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-6 and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations by a professional engineer.
 5. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
 6. Warranty: Sample of special warranty.
- C. Submittals or shop drawings lacking sufficient detail to indicate clear and complete compliance with contract documents shall be rejected. Include plans, elevations, sections, details, and attachments to other work.
- D. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.
- E. Field quality-control reports.
- F. Operation and Maintenance Data: For luminaires, to include in emergency, operation, and maintenance manuals.
- G. Coordinate layout and installation of lighting fixtures with other construction site elements. Provide Drawings: 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. Structural members to which poles and fence materials for lighting fixtures will be attached.

- H. Samples: Upon request, submit for review one representative sample for each or any lighting fixture required under this Contract.
 - 1. The samples must be actual working unit of fixtures to be supplied and shall be submitted complete with cord and plug, wired for 120 Volt operation.
 - 2. After sample acceptance, the fixture shall be sent to the project for use as a standard. In the event the submission is rejected, the fixture will be returned to the manufacturer who shall immediately make a new submission which meets the contract requirements.
- I. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.

1.4 QUALITY ASSURANCE

- A. Equipment Qualifications For Products Other Than Those Specified:
 - 1. If products other than those specified are proposed for use, furnish the name, address, and telephone numbers of at least 5 comparable installations that can prove the proposed products have performed satisfactorily for 3 years. Certify in writing that the Owners of the 5 comparable installations will allow inspection of their installation by the Owner's Representative and the Company Field Advisor.
 - a. Make arrangements with the Owners of 2 installations (selected by the Architect/Engineer) for inspection of the installations by the Architect/Engineer's Representative. Also obtain the services of the Company Field Advisor for the proposed products to be present. Notify the Architect/Engineer a minimum of 3 weeks prior to the availability of the installations for the inspection, and provide at least one alternative date for each inspection.
 - b. Only references from the actual Owner or Owner's representative (Security Supervisor, Maintenance Supervisor, etc.) will be accepted. References from dealers, system installers or others, who are not the actual Owners of the proposed products, are not acceptable. Verify the accuracy of all references submitted prior to submission and certify in writing that the accuracy of the information has been confirmed.
 - 2. The product manufacturer shall have test facilities available that can demonstrate that the proposed products meet the contract requirements.
 - a. Make arrangements with the test facility for the Architect/Engineer's Representative to witness test demonstrations. Also obtain the services of the Company Field Advisor for the proposed product to be present at the test facility. Notify the Architect/Engineer a minimum of 3 weeks prior to the availability of the test facility, and provide at least one alternative date for the testing.
 - 3. Provide written certification from the manufacturer that the proposed products are compatible for use with all other equipment proposed for use for this system and meet all contract requirements.
- B. All lighting fixtures shall be manufactured, furnished, and installed in compliance with all government agencies having jurisdiction. All fixtures shall bear the appropriate UL (or ETL) and IBEW identifications.
- C. Luminaire 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, complying with the IESNA Lighting Measurements Testing & Calculation Guides.
- D. 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.
- E. Mockups: Provide exterior lighting fixtures for in situ mockups complete with power and control connections; the specific design requirements of several building conditions mandates the necessity

of full scale on site mockups prior to final authorization (release) to fabricate.

1. Obtain Architect/Engineer's approval of fixtures for mockups before starting installations.
2. Installation of all luminaire types subject to mockup requirements may not proceed until mockup is accepted by Architect/Engineer.
3. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
4. Approved fixtures in mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
5. Include as part of the bid provision complete mockups for the following fixture types:

TYPE	LOCATION	MAGNITUDE (extent)
AX1a	APM1 - Platform	2 fixtures (4'-0" unit) run
AX3	APM1,2,3 - Adjacent to Guideway	4 fixtures
AX6	APM1,2,3 - Guideway Column	2 fixtures
AX7	APM3 - Commercial Curbside Canopy	2 fixtures
AX8	APM1 - Quad Deck	1 fixture mounted on a pole as a complete assembly
AX9	APM3 - Commercial Curbside Canopy	2 fixtures
AX10	APM1 - Ground Level Canopy	2 fixtures

- F. Manufacturers: all manufacturers listed in the lighting fixture schedule shall be assumed capable of supplying the listed fixtures unless clearly written exceptions are set forth in their quotations. Any such exceptions shall immediately be brought to the attention of the Design Consultant. Manufacturers not listed must comply with the following:

1. Experience: Manufacturers shall have not less than five years' experience in design and manufacturing of lighting fixtures of the type and quality shown. Submission must include a list of completed projects and dated catalogue pages or drawings indicating length of experience.
2. Custom luminaires: Manufacturers shall submit a prototype (pre-fabrication sample) of each fixture for review by the Lighting Designer. Prototypes shall be sufficiently detailed and operational to allow evaluation of compliance with the salient features of the specification. Preliminary design or shop drawings shall not be accepted in place of prototype samples.

1.5 INDUSTRY STANDARDS

- A. Applicability of Standards: Except where more explicit or stringent requirements are written into the Contract Documents, applicable construction industry standards have the same force and effect as if found in or copied directly into the Contract Documents. Such industry standards are made a part of the Contract Documents by reference.
1. Referenced standards (standards referenced directly in the contract documents) take precedence over standards that are not referenced but generally recognized in the industry for applicability to the work.
 2. Unreferenced standards are not directly applicable to the work, except as a general requirement of whether the work complies with recognized construction industry standards.
- B. Publication Dates: Except as otherwise indicated, where compliance with an industry standard is required, comply with the latest standard in effect as of date of Contract Documents.
- C. Conflicting Requirements: Where compliance with two or more standards or criteria is specified, and where these standards establish different or conflicting requirements for minimum quantities or performance quality levels, the most stringent requirement will be enforced, and henceforth provided by the Contractor unless the Contract Documents specifically indicates otherwise. Refer requirements that are different, but apparently equal, and uncertainties as to which quality level is more stringent, to the Design Consultant for a decision before proceeding.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.
 - 1. Warranty Period for Luminaires: (5) Five years from date of Substantial Completion.
 - 2. Warranty Period for Metal Corrosion: five (5) years from date of Substantial Completion.
 - 3. Warranty Period for Color Retention: five (5) years from date of Substantial Completion.
 - 4. Warranty period for LED luminaires inclusive of arrays, modules and drivers: five (5) years from the date of Substantial Completion. Replace all LED components/arrays and fuses that fail within 24 months from date of Substantial Completion; furnish replacement LED components/arrays that fail within the second 24 months from date of Substantial Completion.
 - 5. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than three years from date of Substantial Completion.

1.7 SPARES

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. LED Modules: 1 for every 10 of each type and rating installed. Furnish at least two of each type.
 - 2. Glass, Acrylic and Polycarbonate Lenses, Covers, and Other Optical Parts: 1 for every 10 of each type and rating installed. Furnish at least two of each type.
 - 3. Drivers: 1 for every 10 of each type and rating installed. Furnish at least five (5) of each type.
 - 4. Luminaires: 1 for each 10 [10%] of each type and rating installed. Furnish at least 3 of each type.

1.8 DELIVERY, STORAGE & HANDLING

- A. Light poles and fixtures shall be wrapped for protection during delivery, storage, and handling. Wet or damp wrapping shall be removed, and disposed of, to prevent staining finish.
- B. Deliver materials in manufacturer's original, unopened, protective packaging.
- C. Store materials in original packaging in a manner to prevent soiling and physical damage, prior to installation.
- D. Handle in a manner to prevent damage to finished surfaces.
- E. Where possible, maintain protective covering until installation is complete and remove such coverings as part of final cleanup.

1.9 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

Unless otherwise noted by Civil Engineer:

- A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-6.

- B. Live Load: Single load of 500 lbf, distributed as stated in AASHTO LTS-6.
- C. Ice Load: Load of 3 lbf/sq. ft. applied as stated in AASHTO LTS-6.
- D. Wind Load: Pressure of wind on pole and luminaire, calculated and applied as stated in AASHTO LTS-6.
 - 1. Wind speed for calculating wind load for poles 50 feet or less in height is 110 mph with a 1.3 gust factor.

1.10 COORDINATION

- A. Provide complete systems including, but not limited to: lighting fixtures, drivers, switches, mounting, wiring, control equipment, and other necessary and indicated accessories to install lighting as indicated on Contract Drawings and as specified in this section.
- B. The fixture descriptions indicated in the Luminaire Schedule in the Construction Documents, indicate manufacturer, fixture design, appearance and performance desired.
- C. Fixture locations as indicated on the Electrical drawings are generalized and approximate. Carefully verify locations with Architectural, Landscape and Structural & Civil plans and other reference data prior to installation. Check for adequacy of room and non-interference with other equipment such as underground utilities, or openings. Bring non-standard modifications necessary to comply with the Contract Documents and construction conflicts to Design Consultant's attention before proceeding with Work.
- D. Refer to drawings for dimensions and details. Check and verify dimensions before proceeding with the Work. Clarify any discrepancies with the Design Consultant. Should it appear that the Work intended to be described, is not sufficiently detailed or explained on the drawings or in these specifications, refer to Design Consultant for further drawings or explanations.
- E. Coordinate and schedule the Work of this section with the Work of others sections so there is no delay in the proper installation and completion of any Work. Construction shall proceed in its natural sequence without unnecessary delays or unnecessary cutting and patching caused by the Work of this section.
- F. Arrange scheduling of Work to prevent Work of this section being damaged by other subsequent construction operations. Remove and replace any Work so damaged at no cost to Owner.
- G. Examine the areas and conditions under which exterior lighting is to be installed and remedy conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

1.11 TECHNICAL & ADMINISTRATIVE REQUIREMENTS

- A. All information identified in the Contract Documents shall be considered to form a complete and integrated Specification for Lighting Fixtures.
- B. Specifications and drawings are intended to convey the salient features, function and character of the fixtures only, and do not undertake to illustrate or set forth every item or detail necessary for the work. Minor details not usually indicated on the drawings nor specified, but that are necessary or normally required for the proper execution, completion, installation and operation of the fixtures, shall be included, the same as if they were herein specified or indicated on the drawings.
- C. Omissions: The Owner shall not be held responsible for the omission or absence of any detail,

construction feature, etc. which may be normally required in the production of the lighting fixtures. The full and complete responsibility for accurately purchasing, fabricating and installing the lighting fixtures described herein to the fulfillment of those specifications including compliance with all regulatory bodies (i.e.: UL) shall rest solely with the Contractor.

- D. The Contractor shall be solely responsible for verifying all fixture quantities, lengths and clearances required and shall inform the Design Consultant of job conditions at variance with fixtures as specified or detailed which affect installation or location at the time bid submission is made.
- E. The Contractor shall be solely responsible for coordinating and expediting the timely procurement and delivery for all lighting equipment, lamps, ballasts and related components for the project.
- F. The Contractor shall insure that the lighting fixture manufacturer shall keep on file and make available for review by the Design Consultant and the Architect/Engineer complete Quality Control and Quality Assurance records for all phases of production for all lighting fixtures to be supplied under this project.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide fixtures designed and manufactured specifically for long term outdoor service. Make components, including nuts, bolts, rivets, springs, and similar parts, of corrosion resistant materials or of materials which will assure such resistance.
- B. Provide wet location labeled outdoor fixtures for areas directly exposed to the elements. All upward aiming products shall have a minimum IP rating of 66 (IP66) or as otherwise designated in the lighting fixture schedules.
- C. LED Luminaires: Lighting fixtures shall conform to IES LM-79-08 and LM-80-08 standards. All fixtures shall be RoHS compliant.
- D. Paint metal parts of fixtures with suitable weather and moisture-resisting paint equal to epoxy-based coatings.
- E. Provide anodized aluminum for aluminum parts of exterior fixtures that are not specified as requiring a painted finish.
- F. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by a NRTL acceptable to authorities having jurisdiction.
- G. Lighting fixtures shall be of rigid construction, dimensionally stable, and shall be assembled with secure fastenings. Ferrous parts shall be protected from corrosion by plating or shall be finished with high reflectance enamel with non-yellowing binder and high pigment to binder ratio, with semi-gloss finish. Ferrous parts shall be prepared for finish by industry standard finishing process (see Finishes). Non-ferrous metals (i.e. aluminum) unless otherwise noted be treated with a semi-gloss polyester powder coat enamel finish.
- H. All materials, accessories, and other related fixture parts shall be new and free from defects which in any manner may impair their character, appearance, strength, durability and function, and be effectively protected from any damage or injury from the time of fabrication to the time of delivery.
 - I. For steel and aluminum fixtures all screws, bolts, nuts and other fastening and latching hardware shall be cadmium or equivalent plated. For stainless steel fixtures, all hardware shall be stainless steel. Whenever possible all fasteners shall be captive type. Where indicated provide tamper resistant fasteners.

- J. Include base template, 4 anchor bolts, cadmium-plated hardware and pole grounding lug, hand hole, cast steel anchor base and boltcovers.
- K. Pole foundations: Refer to Civil Engineer's Drawings.
- L. Underground wiring:
 - 1. Type XHHW or THW installed in rigid PVC conduit U.O.N by Electrical Engineer.
 - 2. Provide all wiring runs with separate green equipment grounding conductor, and ground all pole bases.
 - 3. Fixture wiring shall be suitable for the temperature rating of the fixture.
- M. Metal Parts: Free of burrs and sharp corners and edges. All sheet metal work shall be free from tool marks and dents.
- N. Casting: All aluminum, iron or composite casting shall be exact replicas of the approved patterns and shall be free of sand pits, blemishes, scales and rust, and shall be smoothly furnished. Tolerance shall be provided for any shrinkage of the metal castings in order that the finished casting will accurately fit in their designated locations. Unless otherwise noted, for cast aluminum components use copper-free 319 or 443 aluminum alloy only. For cast iron components use ASTM Spec A48-83 Class 30 gray iron.
- O. Furnish and install yokes, brackets and supplementary supporting members needed to mount lighting fixtures to carrier channels or other structure.
- P. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- Q. Welding shall be in accordance with recommendations of the American Welding Society and shall be done with electrodes and/or methods recommended by the manufacturers of the metals being welded. Welds shall be continuous, except where spot welding is specifically permitted. Welds exposed to view shall be ground flush and dressed smooth. All welds on or behind surfaces which will be exposed to view shall be done so that finished surfaces will be free of imperfections such as pits, runs, splatter, cracks, warping, dimpling, depressions or other forms of distortion or discoloration. All welded surfaces shall be free of weld splatter and welding oxides.
- R. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- S. 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.
- T. Exposed Fasteners: All fasteners at every product and assembly exposed to view or accessible with the inpatient environment shall be security Torx tamper resistant and stainless steel.
- U. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- V. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
- W. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 92 Percent.
 2. Specular Surfaces: 87 Percent.
 3. Diffusing Specular Surfaces: 75 Percent.
- X. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- Y. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- Z. Factory-Applied Labels: Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

2.2 SOLID STATE LIGHTING (LED) FIXTURES

- A. General
1. All fixtures shall conform with standards prepared by CIE, IES, UL, and other standards organizations as they apply to solid state lighting technologies. Including but not limited to:
 2. TC2-46 CIE/ISO standards on LED intensity measurements.
 3. TC2-50 Measurements of the optical properties of LED clusters and arrays.
 4. TC2-58 Measurements of LED radiance and luminance.
 5. TC2-63 Optical measurement of High-Power LEDs.
 6. TC2-64 High speed testing methods for LEDs.
 7. Luminaire performance claims shall be measured in accordance with the requirements of IEC/PAS 62612: Edition 1: 2009-06. The testing quantity for LED package lamps shall be a minimum of (20) twenty. The drive current and bin reference should be clearly documented. All manufacturer data to include:
 - a. Luminaire efficacy should be calculated from the initial lumen output of the luminaire that has reached thermal stability operating in an ambient temperature of 25 degrees Celsius and based on the total power of the LEDs and driver circuit.
 - b. Life shall be based on lumen depreciation and failure and shall consist of an endurance test. It shall be clearly noted which part of life and lumen depreciation has been measured and what part has been calculated or extrapolated.
 - c. Lumen depreciation shall be clearly document the length of time a complete LED luminaire provided more than a percentage of the rated luminous flux under standard test conditions. For illuminating luminaires the percentage shall be >80%, indicated as L80 (>80%). For direct view luminaires the percentage should be >50%, indicated as L50.
 - d. Thermal losses: The temperature of the p-n junction of the raw LED (die) (Tj) is to be measured at an ambient temperature of 25 degrees Celsius. In a luminaire the die will be operating at a higher temperature. All performance parameters are to measure the Junction Temperature and Board Temperature.
 - e. Thermal protection: All fixtures shall be provided with appropriate heat sink to maintain lamp life. Stated lamp life and output shall be measured and identified and documented with heat sink. Any variations from stated life or output without heat sink shall be clearly identified including Junction Temperature.
 - f. Warranty: Entire fixture shall carry a minimum 5 year warranty.
 8. Drivers
 - a. Constant current Drivers [non-dimming]: All constant current drivers shall be UL 1310 class 2 including short-circuit protection, high-power factor, with either 12v or 24v input, unless otherwise noted. The driver shall operation on the voltage they are connected to, 120 or 277v input power. Variability in output shall not exceed 5% in load or 1% line levels. Driver shall be designed for use in -40 degree Celsius environments with a high temperature tolerance of +60 degrees ambient, 80 degrees Celsius case rating. Total harmonic distortions shall not exceed

- 20% with a current crest factor of 1.5 maximum. All drivers shall be field replaceable.
- b. Dimming Drivers: All PWM dimming drivers shall be UL 1310 class 2 including short-circuit protection, high-power factor, with either 12v or 24v input, unless otherwise noted. The light output of the LED shall be controlled either by DC voltage applied to the control input (0-10V) with a maximum of 500 microamps per driver. The control equipment must not impose a voltage greater than 11.0V peak maximum on the driver terminals and the short-term transient voltage must not exceed 14 volts. Control equipment intended to control more than one driver must be capable of sinking the current supplied to the control bus by the maximum number of drivers specified for the control device. The control terminals for the driver shall be isolated from the power lines and suitable for use as Class II terminals. Maximum voltage drop not to exceed 0.2 volts. Variability in output shall not exceed 5% in load or 1% line levels. Driver shall be designed for use in -40 degree Celsius environments with a high temperature tolerance of +60 degrees ambient, 80 degrees Celsius case rating. Total harmonic distortions shall not exceed 20% with a current crest factor of 1.5 maximum. All drivers shall be field replaceable.

9. Warranty: Driver shall carry a 5 year warranty

10. All manufacturer data to include LED array and/or module information including but not limited to:

- a. Manufacturer of the LED module with part number or other device identifier.
- b. LED module drive current, voltage, power.
- c. LED module lumen depreciation curves, life, CCT, CRI at an ambient temperature of 25 degrees Celsius.
- d. Board temperature of the LED module installed in the luminaire with proper heat sink, when the luminaire is operating at an ambient temperature of 25 degrees Celsius.
- e. The color bin, CCT, and color shift variation of the LED module at the operating board temperature.
- f. Color rendering index at the operating board temperature.
- g. All lamp modules must be field replaceable/remote phosphor type.
- h. LED lamp modules shall be minimum CRI of 70 with tolerances as identified in Clause 7 IEC/PAS 62612.
- i. White LED modules shall be available in 4000K and 4500K as identified in the lighting fixture schedule.

2.3 LENSES, LOUVERS & DIFFUSERS

- A. All lenses, diffusers, and shielding media shall be properly and securely mounted within fixture assemblies. All fixtures with removable reflectors, or shielding devices shall be supplied with safety chains.
- B. Unless otherwise indicated, all plastic shielding, lenses and diffusers shall be 100% UV stabilized virgin acrylic or polycarbonate.
- C. Unless otherwise indicated, all glass shielding, diffusers or lenses shall be clear tempered borosilicate glass.
- D. Optical lenses shall be free from spherical or chromatic aberrations and other imperfections, which may hinder the functional performance of the lenses.
- E. Mechanical: All lenses, louvers or other light diffusing elements shall be removable but positively held so that hinging or other normal motion will not cause them to drop out.

2.4 FINISHES

- A. Painted surfaces shall be synthetic enamel with acrylic, alkyd, epoxy, polyester or polyurethane base, light stabilized, baked on at 350 degrees Fahrenheit minimum, catalytically or photo chemically polymerized after application.
- B. Optical white finishes: minimum 92% reflectance (semi-gloss).
- C. 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.
- D. Undercoat: Except for stainless steel all ferrous metal surfaces shall be given a five stage phosphate treatment or other acceptable base bonding treatment before final painting and after fabrication.
- E. Unpainted non-reflecting surfaces shall be satin finished and coated with a baked-on clear lacquer to preserve the finish. Where aluminum surfaces are treated with an anodic process, the clear lacquer coating may be omitted.
- F. Unpainted aluminum surfaces: Finish interior aluminum trims with an anodized coating of not less than 7 mg. per square inch, of a color and surface finish as selected by the Design Consultant. Finish exterior aluminum and aluminum trims with an anodized coating of not less than 35 mg. per square inch of a color and surface finish as selected by the Design Consultant.
- G. Metal finishes: Provide finishes of the color and type indicated and having the following properties:
 - 1. Protection of metal from corrosion: 5-year warranty against perforation or erosion of the finish from weathering.
 - 2. Color retention: 5-year warranty against fading, staining, or chalking from weathering including solar radiation.
 - 3. Uniformity: Provide finish of uniform thickness and color, free from streaks, stains or orange peel texture.
- H. Luminaire finishes: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finishes process and color of pole or support materials.

2.5 LIGHTING STANDARDS

- A. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.
- B. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
 - 1. Materials: Shall not cause galvanic action at contact points.
- C. Brackets: Provide brackets, cantilevered and without underbrace of the sizes, styles and finishes indicated with straight tubular and section to accommodate the luminaire.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installing any Work, lay out the proposed course for the conduits, location of lighting standards, etc. and have same approved.

3.2 INSTALLATION: LUMINAIRES

- A. General:

1. Install lighting fixtures as noted on the drawings.
 2. Install luminaires at locations and heights as indicated, in accordance with the manufacturer's written instructions, applicable requirements of NFPA 70, ANSI C2 and with recognized industry practices.
- B. Grounding: Provide equipment grounding connections using branch circuit equipment and connected sufficiently tight to assure a permanent and effective ground. The Contractor shall ground non-current carrying parts of electrical equipment.
- C. Setting and Securing: Set lighting fixtures plumb, square, and level with ceiling and walls, in alignment with adjacent lighting fixtures, and secure in accordance with manufacturers' directions and approved shop drawings.
- D. Coordination: The Contractor shall communicate with other trades as appropriate to properly interface, schedule and coordinate installation of lighting fixtures with other work.
- E. Fixture locations: Do not scale electrical drawings for exact location of the lighting fixtures. In general, the architectural site/landscape plans indicate the proper locations of lighting fixtures, unless otherwise noted on architectural plans.
- F. Instructions: Each lighting fixture shall be packaged with complete illustration and instructions showing how to install.
- G. Splices in internal wiring shall be made with approved insulated "wire nut" type mechanical connectors, suitable for the temperature and voltage conditions to which they are subjected.
- H. All wire utilized for connections to or between individual lamp sockets and lamp auxiliaries (i.e., wires which do not constitute "through circuit" wiring) shall be suitable for temperature, current, and voltage conditions to which it is subjected.
- I. Unless otherwise shown on the Contract Drawings, lighting fixtures and/or fixture outlet boxes shall be provided with hangers to adequately support the complete weight of the lighting fixture.
- J. Installation of fixture locations shall be in strict accordance with the intent of the contract drawings and approved shop, specifications and drawings.
- K. Adjust luminaires that require field adjustment or aiming.
- L. Adjust photosensors prevent false operation of relay by artificial light sources.
- M. Clean lighting fixtures of dirt and debris upon completion of installation.
- N. Protect installed fixtures from damage during remainder of construction period.
- O. The Contractor shall replace blemished, damaged or unsatisfactory fixtures as directed by the Architect/Engineer's representative.

3.3 INSTALLATION: LIGHTING STANDARDS – Not Used

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.

- B. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.5 ADJUST & CLEAN

- A. Clean lighting fixtures of dirt and debris upon completion of installation.
- B. Protect installed fixtures from damage during remainder of construction period.
- C. When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.
 - 1. Adjust aimable luminaires in the presence of Architect/Engineer.
 - 2. As or if required, aiming shall be accomplished at night.

3.6 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Clean lighting fixtures of dirt and debris upon completion of installation.
- C. Protect installed fixtures from damage during remainder of construction period.
- D. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.
 - 1. Verify operation of photoelectric controls.
- E. 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 Installations".
 - b. IESNA LM-72, "Directional Positioning of Photometric Data".
- F. 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.

3.7 AIMING AND ADJUSTMENT

- A. All adjustable lighting units shall be aimed, focused, locked, etc., by the Contractor under the supervision of the Lighting Designer. The Lighting Designer shall indicate the number of crews (foreman and apprentice) required. All aiming and adjusting shall be carried out after the entire installation is complete. All ladders, scaffolds, lift equipment, safety belts, flashlights, walkie talkie equipment, etc. required shall be furnished by the Contractor at the direction of the Lighting Designer. As aiming and adjusting is completed, locking set screws and bolts and nuts shall be tightened securely.
- B. Night work: Where possible, units shall be focused during the normal working day. However, where daylight interferes with seeing, aiming shall be accomplished at night.
- C. Prior to final inspection, relamp all fixtures which have failed lamps, or lamps where visible color shift has occurred, and leave all lighting fixtures, equipment, and accessories in good, uniform operating condition.

END OF SECTION 26 56 29

DIVISION 27

SECTION 27 05 26 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1: GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Provide work specified but not shown on Drawings, and work shown on Drawings but not specified, as though expressly required by both.

1.02 SUMMARY

- A. Section Includes:
 - 1. Grounding conductors.
 - 2. Grounding connectors.
 - 3. Grounding busbars.
 - 4. Grounding labeling.

1.03 DEFINITIONS

- A. BCT: Bonding conductor for telecommunications.
- B. EMT: Electrical metallic tubing.
- C. TBB: Telecommunications bonding backbone
- D. TGB: Telecommunications grounding busbar.
- E. TMGB: Telecommunications main grounding busbar.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.05 INFORMATIONAL SUBMITTALS

- A. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following:
 - 1. BCT, TMGB, TGBs, TBBs and routing of their bonding conductors.
- B. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in operation, and maintenance manuals.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Installation Supervision: Installation shall be under the direct supervision of ITS Technician, who shall be present at all times when Work of this Section is performed at Project site.
 - 2. Field Inspector: Currently registered by BICSI as a Registered Communications Distribution Designer to perform the on-site inspection.

PART 2: PRODUCTS

2.01 SYSTEM COMPONENTS

- A. Comply with latest adopted revision of J-STD-607.

2.02 CONDUCTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Harger Lightning & Grounding.
 - 2. Panduit Corp.
 - 3. Engineer Approved Equal
- B. Comply with UL 486A-486B.
- C. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.
 - 1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
 - 2. Cable Tray Equipment Grounding Wire: No. 6 AWG.
- D. Cable Tray Grounding Jumper:
 - 1. Not smaller than No. 6 AWG and not longer than 12 inches. If jumper is a wire, it shall have a crimped grounding lug with two holes and long barrel for two crimps. If jumper is a flexible braid, it shall have a one-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.
- E. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kmils, 14 strands of No. 17 AWG conductor, and 1/4 inch in diameter.

5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.03 CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. Burndy; Part of Hubbell Electrical Systems.
 2. Chatsworth Products, Inc.
 3. Harger Lightning & Grounding.
 4. Panduit Corp.
 5. Engineer Approved Equal
- B. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.
- C. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.
 1. Electroplated tinned copper, C and H shaped.
- D. Busbar Connectors: Cast silicon bronze, solderless compression-type, mechanical connector; with a long barrel and two holes spaced on 5/8 inch centers for a two-bolt connection to the busbar.
- E. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.04 GROUNDING BUSBARS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. Chatsworth Products, Inc.
 2. Harger Lightning & Grounding.
- B. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by 4 inches in cross section, length as indicated on Drawings. The busbar shall be NRTL listed for use as TMGB and shall comply with J-STD-607.
 1. Predrilling shall be with holes for use with lugs specified in this Section.
 2. Mounting Hardware: Stand-off brackets that provide a 4-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
 3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- C. TGB: Predrilled rectangular bars of hard-drawn solid copper, 1/4 by 4 inches in cross section, length as indicated on Drawings. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with J-STD-607-A.
 1. Predrilling shall be with holes for use with lugs specified in this Section.

2. Mounting Hardware: Stand-off brackets that provide at least a 2-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
 3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- D. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with J-STD-607. Predrilling shall be with holes for use with lugs specified in this Section.
1. Cabinet-Mounted Busbar: Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.
 2. Rack-Mounted Horizontal Busbar: Designed for mounting in 19 in. equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack. See drawings for detailed information concerning rack-mounted horizontal busbars.
 3. Rack-Mounted Vertical Busbar: Designed for mounting inside the vertical wire manager. Vertical busbar shall run the height of the vertical wire manager unless shown otherwise on the drawings. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack. See drawings for detailed information concerning rack-mounted vertical busbars.

2.05 LABELING

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Brother International Corporation.
 2. HellermannTyton.
 3. Engineer Approved Equal
- B. Comply with TIA/EIA-606-C and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

PART 3: EXECUTION

3.01 EXAMINATION

- A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.
- B. Inspect the test results of the ac grounding system measured at the point of BCT connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of the BCT (now TBC) only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.
- B. Comply with NECA 1.
- C. Comply with J-STD-607.

3.03 APPLICATION

- A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
 - 1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
 - 2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
 - 3. The bonding backbone between the TMGB and the TGB in each communications room shall be as detailed on the drawings, but no smaller than No. 3/0 AWG.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2 AWG minimum.
- C. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.
- D. Conductor Support:
 - 1. Secure grounding and bonding conductors at intervals of not less than 36 inches.
- E. Grounding and Bonding Conductors:
 - 1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
 - 2. Install without splices.
 - 3. Install in telecom cable tray or support at not more than 36-inch intervals where cable tray is not available.
 - 4. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 270528 "Pathways for Communications Systems," and bond both ends of the conduit to a TGB

3.04 GROUNDING ELECTRODE SYSTEM

- A. The BCT between the TMGB and the ac service equipment ground shall not be smaller than No. 3/0 AWG.

3.05 CONNECTIONS

- A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.
- B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
- C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:
 - 1. Use crimping tool and the die specific to the connector.
 - 2. Pre-twist the conductor.
 - 3. Apply an antioxidant compound to all bolted and compression connections.
- D. Primary Protector: Bond to the TMGB with insulated bonding conductor.
- E. Interconnections: Interconnect all TGBs to the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than 2 kcmils/linear foot of conductor length, up to a maximum size of No. 3/0 AWG unless otherwise indicated.
- F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install top-mounted rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the TGB with a No. 2 AWG bonding conductors.
- G. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.
- H. Electrical Power Panelboards: Where electrical panelboards for telecommunications equipment is located in the same room or space, bond each TGB to the ground bar of each panelboard.
- I. Shielded Cable: Bond the shield of shielded cable to the TGB in communications rooms and spaces. Comply with TIA/EIA-568-B.1 and TIA/EIA-568-B.2 when grounding screened, balanced, twisted-pair cables.
- J. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.

3.06 IDENTIFICATION

- A. Labels shall be preprinted or computer-printed type.
 - 1. Label TMGB(s) with "fs-TMGB," where "fs" is the telecommunications space identifier for the space containing the TMGB.
 - 2. Label TGB(s) with "fs-TGB," where "fs" is the telecommunications space identifier for the space containing the TGB.
 - 3. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.07 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 2. Test the bonding connections of the system using an AC earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB and a TGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.
 - a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.
 - 3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.
 - a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB and in each TGB. Maximum acceptable ac current level is 1 A.
- C. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 5 ohms, notify Design Consultant promptly and include recommendations to reduce ground resistance.
- D. Grounding system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 27 05 26

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SECTION 27 05 28 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1: GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Provide work specified but not shown on Drawings, and work shown on Drawings but not specified, as though expressly required by both.

1.02 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings.
 - 2. Nonmetallic conduits and fittings.
 - 3. Optical-fiber-cable pathways and fittings.
 - 4. Fire Rated Cable Pathways
 - 5. Smoke Rated Cable Pathways
 - 6. Boxes, enclosures, and cabinets.
 - 7. Buried communication line marking tape

1.03 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid conduit.
- C. IMC: Intermediate metal conduit.
- D. EMT: Electrical Metallic Tubing

1.04 ACTION SUBMITTALS

- A. Product data: For each type of product.

1.05 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of pathway groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Source quality-control reports.

PART 2: PRODUCTS

2.01 METAL CONDUITS AND FITTINGS

- A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. AFC Cable Systems; a part of Atkore International.
 - 2. Allied Tube & Conduit; a part of Atkore International.
 - 3. Alpha Wire.
 - 4. Anamet Electrical, Inc.
 - 5. Electri-Flex Company.
 - 6. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - 7. Picoma Industries, Inc.
 - 8. Plasti-Bond.
 - 9. Republic Conduit.
 - 10. Southwire Company.
 - 11. Thomas & Betts Corporation; A Member of the ABB Group.
 - 12. Western Tube and Conduit Corporation.
 - 13. Engineer Approved Equal.
- C. General Requirements for Metal Conduits and Fittings:
 - 1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
 - 2. Comply with TIA-569-D.
- D. GRC: Comply with ANSI C80.1 and UL 6.
- E. IMC: Comply with ANSI C80.6 and UL 1242.
- F. EMT: Comply with ANSI C80.3 and UL 797.
- G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 - 1. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: compression.
 - 2. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
- H. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.02 NONMETALLIC CONDUITS AND FITTINGS

- A. Description: Nonmetallic raceway of circular section with manufacturer-fabricated fittings.

- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. AFC Cable Systems; a part of Atkore International.
 - 2. Allied Tube & Conduit; a part of Atkore International.
 - 3. Anamet Electrical, Inc.
 - 4. Arnco Corporation.
 - 5. CANTEX INC.
 - 6. Carlon; a brand of Thomas & Betts Corporation.
 - 7. CertainTeed Corporation.
 - 8. Condux International, Inc.
 - 9. Dura-Line.
 - 10. Electri-Flex Company.
 - 11. Kraloy.
 - 12. Lamson & Sessions.
 - 13. Niedax Inc.
 - 14. RACO; Hubbell.
 - 15. Engineer Approved Equal.
- C. General Requirements for Nonmetallic Conduits and Fittings:
 - 1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
 - 2. Comply with TIA-569-D.
- D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- E. Fittings: Comply with NEMA TC 3; match to conduit or tubing type and material.
- F. Solvents and Adhesives: As recommended by conduit manufacturer.

2.03 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

- A. Description: Comply with UL 2024; flexible-type pathway with a circular cross section, approved for plenum installation unless otherwise indicated.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Alpha Wire.
 - 2. Carlon; a brand of Thomas & Betts Corporation.
 - 3. Dura-Line.
 - 4. Endot Industries Inc.
 - 5. Engineer Approved Equal.
- C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with TIA-569-D.

2.04 FIRE RATED CABLE PATHWAYS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Hilti North America - Firestop Speed Sleeve
 - 2. Wiremold/Legrand Flamestopper
 - 3. Specified Technologies Inc. (STI) - EZ Path Fire-Rated Pathway
 - 4. Engineer Approved Equal
- B. General Requirements for fire rated cable pathways:
 - 1. Fire rated cable pathway devices shall be used in fire-rated construction for low-voltage, video, data and voice cabling and optical fiber cabling at locations shown on the drawings.
 - 2. Fire rated cable pathways shall contain a built-in fire sealing system sufficient to maintain the hourly fire-rating of fire rated wall and or floor penetrated.
 - 3. The self-contained sealing system shall adjust to the installed cable loading and shall permit cables to be installed or removed without the need to remove or reinstall firestop materials.
 - 4. Fire rated cable pathways shall be engineered such that two or more devices may be ganged together for larger cable capacities.
 - 5. Affix adhesive wall label immediately adjacent to devices to communicate to future cable technicians, authorities having jurisdiction and others the manufacturer of the device and the corresponding UL System number installed.
 - 6. Fire rated cable pathway shall replace conduit sleeves with firestop sealant/putty in walls and floors, and;
 - a. When installed individually in walls/floors, devices shall pass through core-drilled opening utilizing tested wall/floor plates.
 - b. When multiple units are ganged in walls/floors, devices shall be anchored by means of a tested grid.
 - 7. Cable tray/cable runway shall terminate at each wall/floor and resume on the other side such that cables pass independently through fire rated pathway devices. Cable tray/cable runway shall be properly supported on each side of the wall/floor.
 - 8. Fire rated cable pathways shall be UL Classified and/or FM Systems Approved and tested to the requirements of ASTM E814 (UL1479).

2.05 SMOKE RATED CABLE PATHWAYS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Specified Technologies Inc. (STI) - EZ Path Smoke and Acoustical
 - 2. Engineer Approved Equal
- B. General Requirements for smoke rated cable pathways:
 - 1. All data, video, and communications cable bundles shall utilize an enclosed smoke and acoustical pathway device wherever said cables penetrate non-fire-rated walls.
 - 2. The smoke and acoustical pathway shall contain a built-in sealing system and shall automatically adjust to the installed cable loading and shall permit cables to be installed, removed, or retrofitted without the need to remove or reinstall acoustical materials.
 - 3. The pathway shall provide an achievable STC rating of greater than or equal to the STC rating of the specific underlying construction per ASTM E90-04/ASTM C919.

4. After installation in a barrier, cables can be easily added or removed at any time without the need to remove or reinstall caulking materials.
5. Pathway shall meet UL 2043.
6. Provide smoke-rated pathway by STI EZ-Path, Model No. NEZ33-W.

2.06 BOXES, ENCLOSURES, AND CABINETS

- A. Description: Enclosures for communications.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Adalet.
 2. Carlon; a brand of Thomas & Betts Corporation.
 3. Crouse-Hinds, an Eaton business.
 4. EGS/Appleton Electric.
 5. Erickson Electrical Equipment Company.
 6. FSR Inc.
 7. Hoffman; a brand of Pentair Equipment Protection.
 8. Milbank Manufacturing Co.
 9. Molex Industrial Products Group; Woodhead Brand.
 10. MonoSystems, Inc.
 11. Oldcastle Enclosure Solutions.
 12. O-Z/Gedney; a brand of Emerson Industrial Automation.
 13. Plasti-Bond.
 14. Quazite: Hubbell Power Systems, Inc.
 15. Randl Industries, Inc.
 16. Siemon
 17. Steel City
 18. Engineer Approved Equal.
- C. General Requirements for Boxes, Enclosures, and Cabinets:
 1. Comply with TIA-569-D.
 2. Boxes, enclosures, and cabinets installed in wet locations shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for use in wet locations.
 3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
 4. Device Box Dimensions: 5 inches square by 3 inches deep.
 5. Device Box Accessories: Integral cable management.
- D. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- E. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.
- H. Hinged-Cover Enclosures and Cabinets: Comply with UL 50 and NEMA 250, with continuous-hinge cover, screw down clamps, padlock hasp and mounting panel unless otherwise indicated.
 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2. Nonmetallic Enclosures:
 - a. Material: Fiberglass.
 - b. Finished inside with radio-frequency-resistant paint.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
4. Accessory feet where required for freestanding equipment.
5. Refer to drawings for required NEMA ratings.

2.07 BURIED COMMUNICATION LINE MARKING TAPE

- A. Underground Communication Line Marking Tape: Permanent, bright-colored, continuous-printed, plastic, tape compounded for direct-burial service not less than 6 inches wide by 4 mils thick. Printed legend shall be indicative of general type of underground line below, such as "CAUTION - BURIED COMMUNICATION LINE BELOW". Tape shall have integral metallic facing or metallic core to allow locating buried tape with electronic detection equipment.

PART 3: EXECUTION

3.01 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
 1. Exposed Conduit: GRC.
 2. Concealed Conduit, Aboveground: GRC.
 3. Underground Conduit: RNC, Type EPC-40-PVC.
 4. Boxes and Enclosures, Aboveground: NEMA 250, Type 4.
- B. Indoors: Apply pathway products as specified below unless otherwise indicated:
 1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 3. Exposed and Subject to Severe Physical Damage: GRC. Pathway locations include the following:
 - a. Corridors used for traffic of baggage tugs and carts.
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 5. Damp or Wet Locations: IMC.
 6. Pathways for Non-Armored-Optical-Fiber Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway.
 7. Pathways for Non-Armored-Optical-Fiber Cable Risers in Vertical Shafts: Riser-type, optical-fiber-cable pathway.
 8. Pathways for Concealed General-Purpose Distribution of Non-Armored-Optical-Fiber Cable: Plenum-type, optical-fiber-cable pathway.
 9. Pathways for MPO fiber optic trunk cable inside Communication Rooms: Split wall, plenum-type, optical-fiber-cable pathway.
 10. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel units in institutional and commercial kitchens and NEMA 250, Type 4 painted steel units in damp or wet locations.

- 11. Optical-fiber-cable pathway not required for armored optical fiber.
- C. Minimum Pathway Size: 3/4-inch (21-mm) trade size for copper cables, and 1 1/2 inch (25 mm) for optical-fiber cables.
- D. Pathway Fittings: Compatible with pathways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 - 2. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface pathways only where indicated on Drawings.

3.02 INSTALLATION

- A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:
 - 1. NECA 1.
 - 2. NECA/BICSI 568.
 - 3. TIA-569-D.
 - 4. NECA 101
 - 5. NECA 102.
 - 6. NECA 105.
 - 7. NECA 111.
- B. Cabling shall be concealed where possible and shall be installed as follows
 - 1. Cables concealed inside hollow wall construction shall be installed in conduits stubbed into accessible ceiling cavities.
 - 2. Cables installed in accessible ceiling cavities shall be supported with cable tray or J-Hook supports.
 - 3. Cables located in rooms with an exposed ceiling structure shall be installed in conduit.
 - 4. Cables installed above inaccessible ceilings shall be installed in conduit.
 - 5. It is acceptable to fish flexible metal conduit inside existing hollow walls and above existing inaccessible ceilings.
 - 6. Cables installed outdoors shall be installed in conduit.
 - 7. Cables installed in casework shall be installed in conduit.
 - 8. Route conduit and cables to suit field conditions.
- C. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- D. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- E. Comply with requirements in Section 270529 "Hangers and Supports for Communications Systems" for hangers and supports.
- F. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- G. Complete pathway installation before starting conductor installation.

- H. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- I. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches (300 mm) of changes in direction. Utilize long radius ells for all optical-fiber cables.
- J. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- K. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- L. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for pathways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- M. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- O. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus one additional quarter-turn.
- P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure, to assure a continuous ground path.
- Q. Cut conduit perpendicular to the length. For conduits of 2-inch (50-mm) trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- R. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.
- S. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
 - 1. 1-Inch (25-mm) Trade Size and Larger: Install pathways in maximum lengths of 75 feet (23 m).
 - 2. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- T. Install pathway-sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway-sealing fittings according to NFPA 70.
- U. Install suitable pliable compound to seal pathway interiors at accessible locations. Locate seals, so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where an underground service pathway enters a building or structure.
 3. Where an above grade pathway enters or exits a building structure.
 4. Where otherwise required by NFPA 70, Article 300.7 (A).
- V. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
- W. Expansion-Joint Fittings:
1. Install in each run of aboveground PVC that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground metal that is located where environmental temperature change may exceed 100 deg F (55 deg C), and that has straight-run length that exceeds 100 feet (30 m).
 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
 - d. Attics: 135 deg F (75 deg C) temperature change.
 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
 4. Install expansion fittings at all locations where conduits cross building or structure expansion and seismic joints.
 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- X. Fire Rated Pathways
1. Before beginning installation, verify that substrate conditions previously installed under other sections are acceptable for installation of firestopping in accordance with manufacturer's installation instructions and technical information.
 2. Install systems in accordance with Performance Criteria and in accordance with the conditions of testing and classification as specified in the published design.
 3. Comply with manufacturer's instructions for installation of products.
 4. Place system stickers on each side of wall penetrations.
- Y. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- Z. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

- AA. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.
- BB. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
 - 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe of less than 6 inches (150 mm) in nominal diameter.
 - 2. Install backfill as specified in Section 312000 "Earth Moving."
 - 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
 - 4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete around conduit for a minimum of 12 inches (300 mm) on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
 - 5. Buried Communication Line Warning Tape: Bury warning tape approximately 12 inches above all underground communication conduits.

3.04 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.05 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage or deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 27 05 28

SECTION 27 05 29 - HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1: GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Provide work specified but not shown on Drawings, and work shown on Drawings but not specified, as though expressly required by both.

1.02 SUMMARY

- A. Section Includes:
 - 1. Steel slotted support systems for communication raceways.
 - 2. Conduit and cable support devices.
 - 3. Support for digital displays and projectors.
 - 4. Support for conductors in vertical conduit.
 - 5. Structural steel for fabricated supports and restraints.
 - 6. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
 - 7. Fabricated metal equipment support assemblies.
 - 8. Design of Seismic restraint systems

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Slotted support systems, hardware, and accessories.
 - b. Clamps.
 - c. Hangers.
 - d. Brackets.
 - 2. Include rated capacities and furnished specialties and accessories.
- B. Shop Drawings: Fabrication and installation details for communications hangers and support systems signed and sealed by a qualified professional engineer, licensed in the state where Project is located, who is responsible for their preparation.
 - 1. Trapeze hangers. Include product data for components.
 - 2. Equipment supports.
- C. Delegated-Design Submittal: For hangers and supports for communications systems signed and sealed by a qualified professional engineer, licensed in the state where Project is located, who is responsible for their preparation.

1. Include design calculations for seismic requirements and code required restraints.
2. Include seismic restraint details.

1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Suspended ceiling components.
 2. Ductwork, piping, fittings, and supports.
 3. Structural members to which hangers and supports will be attached.
 4. Size and location of initial access modules for acoustical tile.
 5. Items penetrating finished ceiling, including the following:
 - a. Luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Projectors.
- B. Seismic Qualification Certificates: For hangers and supports for communications equipment and systems, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.05 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

PART 2: PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design hanger and support system.
- B. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."
 2. Component Importance Factor: 1.5.

2.02 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch- (10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface. Provide fittings and accessories that mate and match with steel slotted support systems and are of the same manufacturer.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. B-line, an Eaton business.
 - b. Unistrut; Part of Atkore International.
 - c. Engineer Approved Equal.
 - 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 3. Material for Channel, Fittings, and Accessories: Galvanized steel.
 - 4. Channel Width: Selected for applicable load criteria.
 - 5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 6. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
 - 7. Channel Dimensions: Selected for applicable load criteria.
 - 8. Provide steel channels with hot-dip galvanized finish for all outdoor locations.
- B. Conduit and Cable Support Devices: Steel clamps, hangers, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for digital displays and projectors: Steel channels, steel clamps, hangers, and associated fittings designed for types and sizes of digital display and projector mounting brackets.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored communications conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Hilti, Inc.
 - 2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.

2. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) B-line, an Eaton business.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti, Inc.
 - 4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.03 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3: EXECUTION

3.01 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 1. NECA 1.
 2. NECA/BICSI 568.
 3. TIA-569-D.
 4. NECA 101
 5. NECA 102.
 6. NECA 105.
 7. NECA 111.
- B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for pathways specified in Section 270528 "Pathways for Communications Systems."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.

3.02 SUPPORT INSTALLATION

- A. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- B. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten communications items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Use approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Use expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated-driven threaded studs, provided with lock washers and nuts, may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
 - 6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
 - 7. To Light Steel: Sheet metal screws.
 - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.
- C. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor communications materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.04 PAINTING

- A. Touchup: 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 (0.05 mm).
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 27 05 29

SECTION 27 05 43 - UNDERGROUND PATHWAYS AND STRUCTURES FOR COMMUNICATION SYSTEMS

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.
- B. Provide work specified but not shown on Drawings, and work shown on Drawings but not specified, as though expressly required by both.

1.2 SUMMARY

- A. Section Includes:
 - 1. Conduit and accessories for direct-buried and directionally bored runs.
 - 2. Composite Handholes (TYPE 1).
 - 3. Pre-Cast Concrete Handholes and Covers (Airport Construction Casting) (TYPE 2).

1.3 DEFINITION

- A. RNC: Rigid nonmetallic conduit.
- B. HDPE: High Density Polyethylene.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Handholes (TYPE 1 & TYPE 2).
 - 2. Continuous HDPE tubing

1.5 QUALITY ASSURANCE

- A. Comply with IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with ASTM F 2160.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

- B. Store underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Services: Do not interrupt services to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary services according to requirements indicated:
 - 1. Notify Owner no fewer than 10 days in advance of proposed interruption of services.
 - 2. Do not proceed with interruption of services without Owner's written permission.

1.8 COORDINATION

- A. Coordinate layout and installation of ducts and handholes with final arrangement of other utilities, site grading, and surface features as determined in the field.
- B. Coordinate elevations of ducts and duct-bank entrances into handholes, and pull boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and as approved by Engineer.

PART 2 - PRODUCTS

2.1 CONDUIT

- A. RNC: NEMA TC 2, Type EPC-40-PVC and Type EPC-80-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.
- B. Continuous HDPE: Smoothwall, SDR-11 minimum, Comply with UL 651B.

2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AFC Cable Systems.
 - 2. ARNCO Corporation.
 - 3. Beck Manufacturing.
 - 4. Cantex, Inc.
 - 5. CertainTeed Corp.
 - 6. Condux International, Inc.
 - 7. DCX-CHOL Enterprises, Inc.; ELECSYS Division.
 - 8. Electri-Flex Company.
 - 9. IPEX Inc.
 - 10. Lamson & Sessions; Carlon Electrical Products.
 - 11. Manhattan Wire Products; a Belden company.
 - 12. Dura-Line – HDPE
 - 13. Carlon

- B. Underground Plastic Utilities Duct: Schedule 40 PVC with matching fittings by the same manufacturer as the duct, complying with NEMA TC 9.
- C. Duct Accessories:
 - 1. Warning Tape: Underground-line warning tape specified in Division 26 Section "Identification for Electrical Systems."
- D. Underground HDPE Tubing for use with Directional Boring: Continuous, Smoothwall, SDR-11 minimum.

2.3 COMPOSITE HAND HOLES (TYPE-1)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - 1. Quazite (Hubbell) Products. (Basis of Design)
 - 2. Oldcastle Precast, Inc.
 - 3. Armorcast Products.
 - 4. Duravault.
- B. Polymer concrete, complete with cover, cover label, accessories, hardware, and features.
- C. Tier 22 rated. Comply with ANSI/SCTE 77 performance requirements. See contract document drawings for additional information and details.

2.4 PRECAST CONCRETE HAND HOLES AND COVERS (TYPE-2)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - 1. Christy Concrete Products.
 - 2. Crest Precast, Inc.
 - 3. Cretex Concrete Products West, Inc.; Riverton Division.
 - 4. Elmhurst-Chicago Stone Co.
 - 5. Oldcastle Precast Inc.; Utility Vault Division.
 - 6. Utility Concrete Products, LLC.
 - 7. Wausau Tile Inc.
- B. Comply with ASTM C 858. Provide accessories, hardware, and features.
 - 1. Spring-Assist Hatch Assembly: Iron frame with ductile iron lid and lid mounted springs load tested to 200,000 pounds. Comply with FAA Advisory Circular AC150/5370-6D, and FAA Advisory Circular AC150/5370-10A. Slam latch assembly and hold open device.
 - 2. Duct Entrances in Handhole Walls: Core drilled.
 - 3. Vertical Unistrut: Wall mounted, 2 sections per handhole wall.
- C. Precast units shall be installed plumb and true. Joints shall be made watertight by use of sealant at each tongue-and-groove joint and at roof of handhole. Excess sealant shall be removed and severe surface projections on exterior of neck shall be removed

- D. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.
 - 1. Cover Legend: Cast in. Retained to suit system.
 - a. Legend: "FIBER" for ducts systems with fiber optic cable for communications, data and security systems.

PART 3 - EXECUTION

3.1 UNDERGROUND DUCT APPLICATION

- A. Underground Ducts for Communications: Continuous HDPE: Installed in direct-buried duct bank unless otherwise indicated.

3.2 UNDERGROUND ENCLOSURE APPLICATION

- A. Handholes and Pull Boxes for 600 V and Less, Including Telephone, Communications, and Data Wiring:
 - 1. Units in Aircraft Runway Traffic Paths: Type 2 as indicated on the contract document drawings. Precast concrete.
 - 2. Units in Driveway, Parking Lot, and Roadway Locations: Type 1 as indicated on the contract document drawings. Polymer concrete.

3.3 EARTHWORK

- A. Excavation and Backfill: Comply with ODOT Specifications but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restore surface features at areas disturbed by excavation and reestablish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Spec Section ODOT 230 "Sodding and Sprigging".

3.4 EXTERIOR IMPROVEMENTS

- A. Cut existing pavement, curb and gutter or sidewalk in the path of underground ducts and utility structures as needed according to ODOT Specifications.
- B. Patch existing pavement, curb and gutter or sidewalk as shown on contract drawings and according to Spec Sections ODOT 411 "Hot Mix Asphalt", ODOT 701 "Portland Cement Concrete".

3.5 DUCT INSTALLATION

- A. Slope: Pitch ducts a minimum slope of 1:300 down toward handholes and away from buildings and equipment. Slope ducts from a high point in runs between two handholes to drain in both directions.
- B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations unless otherwise indicated.
- C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
- D. Building Wall Penetrations: Seal watertight. All above grade exposed conduit shall be galvanized rigid steel. Transition from HDPE/duct to rigid steel just below the grade line so that all exposed above ground conduit is galvanized rigid steel. Couple steel conduits to HDPE/duct with adapters designed for this purpose. Install conduit penetrations of building walls as specified in Division 26 Sections.
- E. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- F. Pulling Cord: Install 100-lbf test nylon cord in ducts, including spares.
- G. Directionally Bored Underground Conduits:
 - 1. Install continuous HDPE conduit underground and for stub-ups at poles and equipment and at building entrances through the floor unless otherwise indicated. Exposed above grade conduit shall be galvanized rigid steel.
 - a. Couple steel conduits to HDPE with adapters designed for this purpose. Coupling shall occur just below the grade line so that all exposed above grade conduit is galvanized rigid steel.

3.6 INSTALLATION OF HANDHOLES, AND PULL BOXES

- A. Handhole Installation:
 - 1. Comply with ASTM C 891 unless otherwise indicated.
 - 2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
 - 3. Prepare base and backfill and install per the details on contract document drawings.

3.7 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
- B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.8 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of handholes. Remove foreign material.

3.9.1 AS-BUILT PLAN

Provide the Engineer a complete set of As-Built Plans showing all newly installed hand holes and camera poles within 30 calendar days of completing the work. Ensure that the plans are dimensionally correct copies of the Contract plans and include handhole and conduit locations. Plans must be the same scale as the Contract plans. Submittal of electronic plans data in lieu of hard copy plans is preferred and may be approved by the Engineer if compatible with the Department software.

END OF SECTION 27 05 43

SECTION 27 11 00 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1: GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Provide work specified but not shown on Drawings, and work shown on Drawings but not specified, as though expressly required by both.

1.02 SUMMARY

- A. Section Includes:
 - 1. Backboards.
 - 2. Telecommunications equipment racks and cabinets.
 - 3. Power distribution units (PDU).
 - 4. Cable runway
 - 5. Uninterruptable Power Supplies (UPS)
- B. Related Requirements:
 - 1. Section 270526 "Grounding and Bonding for Communications Systems" for grounding associated with system panels and devices.
 - 2. Section 270536 "Cable Trays for Communications Systems" for cable trays and accessories.
 - 3. Section 271313 "Communications Copper Backbone Cabling" for copper data cabling associated with system panels and devices.
 - 4. Section 271323 "Communications Optical Fiber Backbone Cabling" for optical fiber data cabling associated with system panels and devices.
 - 5. Section 271513 "Communications Copper Horizontal Cabling" for copper data cabling associated with system panels and devices.
 - 6. Section 271523 "Communications Optical Fiber Horizontal Cabling" for optical fiber data cabling associated with system panels and devices.
 - 7. Section 280513 "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.03 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. LAN: Local area network.
- C. RCDD: Registered Communications Distribution Designer.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.
1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- C. Delegated-Design Submittal: For seismic restraints.
1. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer, licensed in the state where Project is located, who is responsible for their preparation.
 2. Design Calculations: Calculate requirements for selecting seismic restraints.
 3. Detail fabrication, including anchorages and attachments to structure.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Seismic Qualification Certificates: For equipment racks and cabinets from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions. Base certification on the maximum number of components capable of being mounted in each rack type. Identify components on which certification is based.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD.
 2. Field Inspector: Currently registered by BICSI as RCDD to perform the on-site inspection.

PART 2: PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic restraints.
- B. Seismic Performance: Equipment racks and cabinets shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

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."

2.02 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels specified in Section 061053 "Miscellaneous Rough Carpentry."
- B. Install backboards starting at 12" AFF with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joint, unless noted otherwise on drawings.
- C. Backboards shall be painted with white, fire retardant paint (leaving the certification label exposed and unpainted) on all sides. Backboards shall be painted prior to installation.

2.03 TELECOMMUNICATIONS EQUIPMENT RACKS AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. APC by Schneider Electric
 2. Chatsworth Products, Inc.
 3. Hubbell Premise Wiring.
 4. Leviton Manufacturing Co., Inc.
 5. Middle Atlantic Products, Inc.
 6. Ortronics, Inc.
 7. Panduit Corp.
 8. Great Lakes Case & Cabinet Co., Inc.
 9. Engineer Approved Equal
- B. General Frame Requirements:
 1. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
 2. Module Dimension: Width compatible with EIA 310-D standard, 19-inch (480-mm) panel mounting.
 3. Finish: Manufacturer's standard, baked-polyester powder coat.
- C. 2-Post Open Frame Relay Racks
 1. Size: Fully adjustable 19-inch mounting verticals. Overall height shall be 84" with a minimum of 45 RU.
 2. Construction:
 - a. Racks shall be manufactured from aluminum extrusion. Each rack shall have two L-shaped top angles, two L-shaped base angles and two C-shaped equipment-mounting channels. The base angles shall be pre-punched for attachment to the floor. Baked-polyester powder coat finish.
 - b. Equipment mounting channels shall be 3" deep and punched on the front and rear flange with the EIA-310-D Universal hole pattern, 1-3/4" rack-mount units (RU),

to provide 45RU for equipment. Each mounting space (RU) shall be marked and numbered on the mounting channel.

- c. Equipment attachment points shall be drilled and tapped on both sides with 12-24 mounting holes at universal EIA spacing.

- 3. Mounting: All racks shall be floor mounted and permanently fixed to the floor with bolt-down kits. Multiple racks shall be connected together.
- 4. Grounding: Provide grounding busbar as shown on drawings. Busbar shall consist of a 19" horizontal ground bar and/or a vertical ground bar installed inside the vertical wire managers. The busbar shall be connected to the perimeter grounding conductor with an irreversible compression fitting. All non-conductive coatings such as paint, lacquer, etc. shall be removed prior to making a ground connection at any point on the rack or cabinet.

D. Data Cabinets:

- 1. Size: Fully adjustable 19-inch mounting verticals. Overall minimum dimensions shall be 30" wide, 42" deep with an overall height of 84", with at least 45 RU.
- 2. Panels: Front, side, bottom and top panels shall be fully and easily removable by a latching mechanism. Front and rear panels shall be vented to allow airflow with a keyed locking mechanism, all cabinets shall be keyed alike. Bottom panel shall be vented for airflow and slotted for cable access from below.
- 3. Construction: The frame shall be made of extruded aluminum. Adjustable vertical mounting rails shall be drilled and tapped with 12-24 mounting holes at universal EIA spacing.
- 4. Cable Management: Cabinets shall contain integral vertical cable managers on both sides of the cabinet. Cable management shall run the entire height of the cabinet. If managers are not integral provide vertical cable managers as specified elsewhere in this specification.
- 5. Mounting: All cabinets shall be floor mounted with adjustable leveling feet and permanently fixed to the floor with bolt-down kits. Multiple cabinets shall be connected together with side panels removed for routing of cables between cabinets, provide ganging kits as required.
- 6. Grounding: Provide a 19" grounding busbar that accepts 2-hole grounding lugs in the top of each cabinet on the back side of the cabinet. The busbar shall be connected to the perimeter grounding conductor with an irreversible compression fitting. All non-conductive coatings such as paint, lacquer, etc. shall be removed prior to making a ground connection at any point on the cabinet.

E. Server Cabinets:

- 1. Size: Fully adjustable 19-inch mounting verticals. Overall minimum dimensions shall be 30" wide, 48" deep with an overall height of 84", with at least 45 RU.
- 2. Panels: Front, side, bottom and top panels shall be fully and easily removable by a latching mechanism. Front and rear panels shall be vented to allow airflow with a keyed locking mechanism, all cabinets shall be keyed alike. Bottom panel shall be vented for airflow and slotted for cable access from below. Coordinate keying requirements with owner.
- 3. Construction: The frame shall be made of extruded aluminum. Adjustable vertical mounting rails shall be drilled and tapped with 12-24 mounting holes at universal EIA spacing.
- 4. Mounting: All cabinets shall be floor mounted with adjustable leveling feet and permanently fixed to the floor with bolt-down kits. Multiple cabinets shall be connected together with side panels removed for routing of cables between cabinets, provide ganging kits as required.
Grounding: Provide grounding busbar as shown on drawings. Busbar shall consist of a 19" horizontal ground bar and/or a vertical ground bar installed inside the vertical wire managers. The busbar shall be connected to the perimeter grounding conductor with an irreversible compression fitting. All non-conductive coatings such as paint, lacquer, etc. shall be removed prior to making a ground connection at any point on the rack or cabinet.

F. Co-Location Cabinets:

1. Section Quantity: Co-location cabinets shall be provided with the quantity of sections as shown on the drawings.
2. Size: Fully adjustable 19-inch mounting verticals. Overall minimum dimensions shall be 30" wide, 42" deep with an overall height of 84". 2-section cabinets shall provide 21 RU per section; 3-section cabinets shall provide 14 RU per section.
3. Panels: Front, side, bottom and top panels shall be fully and easily removable by a latching mechanism. Front and rear section doors shall be vented to allow airflow with a keyed locking mechanism. Each section shall be keyed differently, front and rear doors of the same section shall be keyed alike. Bottom panel shall be slotted for cable access from below.
4. Keys: Individual keys shall be provided for each section. A grand master key shall be provided for all sections in all co-location cabinets provided under this project. Coordinate keying requirements with the owner.
5. Construction: The frame shall be made of extruded aluminum. Adjustable vertical mounting rails shall be drilled and tapped with 12-24 mounting holes at universal EIA spacing. Each compartment in the cabinet shall include two pairs of equipment mounting rails. Mounting rails shall bolt to the supports located near the top and bottom of the compartment and shall be fully adjustable in depth to provide front and rear support for equipment.
6. Cable Management: Cabinets shall include integral vertical cable management pathways that segregate and secure cables from each section.
7. Mounting: All cabinets shall be floor mounted with adjustable leveling feet and permanently fixed to the floor with bolt-down kits. Multiple cabinets shall be connected together with side panels removed for routing of cables between cabinets, provide ganging kits as required.
8. Grounding: Provide a 19" grounding busbar that accepts 2-hole grounding lugs in the top of each section on the back side of the cabinet. Daisy-chain multiple busbars with the top-most busbar being connected to the perimeter grounding conductor with an irreversible compression fitting. All non-conductive coatings such as paint, lacquer, etc. shall be removed prior to making a ground connection at any point on the cabinet.

G. Wall Mounted Cabinets:

1. Wall-mounted cabinets shall be manufactured from steel sheet.
2. Each cabinet will have a rear panel that attaches to the wall, a hinged cabinet body that swings open from the rear panel providing easy access to the rear of equipment and a locking front door.
3. The rear panel will be 5" deep and will provide cable access with pre-punched knockouts for conduit along the top and bottom edges of the panel. There will be a minimum of (4) combination 1/2" and 3/4" conduit knockouts (2 top/2 bottom) and (8) combination 2-1/2" and 3" knockouts (4 top/4 bottom). The back edge of the knockouts will be located 1-5/8" from the back surface of the panel (cabinet/wall) allowing conduit to be attached to the wall with auxiliary framing strut. The cabinet will include rubberized or plastic/composite grommets that fit within the 3" knockouts to protect cables when conduit is not used to route cables. There will also be cutouts in the back of the rear panel so that cables can enter the panel through the wall. The rear panel will provide attachment points for accessory equipment mounting brackets and cable tie points within the panel (cabinet).
4. The cabinet body will include a two pairs of vertical 19" EIA equipment mounting rails. The mounting rails will be EIA-310-D compliant with the Universal hole pattern. Mounting holes will be spaced vertically on alternating 5/8"-5/8"-1/2" centers and will be roll-formed with #12-24 threads. Mounting rails will provide quantity of rack-mount spaces (RMU) for equipment as shown on drawings.

5. Mounting rails will be adjustable in depth so that they can be positioned at any point within the cabinet body. The design of all cabinets will allow for a total of two pairs of mounting rails per cabinet.
6. In cabinets that wall-mount only, mounting rails will bolt in place directly to the cabinet frame. The mounting rails will be L-shaped. The side of the mounting rails will be punched to provide lacing points for cables.
7. In cabinets that wall-mount only, the hinge design that attaches the cabinet body and the rear panel will allow the rear panel to be removed during installation.
8. For all cabinets, the hinge that attaches the cabinet body and the rear panel will allow the cabinet body to open at least 90°. The hasp used to secure the rear panel and the cabinet body together will assist in drawing the components together during the locking action.
9. The cabinet body will include vents that are designed to accept fan kits. The manufacturer of the cabinet will sell compatible fan and filter kits as an accessory.
10. The front door will be hinged and locking. The front door and rear panel will be keyed alike. The front door will have rounded edges and corners. The cabinet body will allow the front door to be attached so that it will swing open from the right or left. The front door will be solid or have a tinted window, as specified below.
11. Finish shall be epoxy-polyester hybrid powder coat (paint) in black. Mounting rail supports in cabinets that are floor-supported with a wheeled base are anodized aluminum. Tinted windows in doors shall be bronze acrylic (not clear) with a UL flammability classification of 94HB or better.
12. The cabinet shall be delivered fully assembled and will include installation hardware (hex lag screws) for wood studs and 50 each #12-24 equipment mounting screws.
13. Load bearing capacity for cabinets that wall-mount only will be 200 pounds per cabinet. Load bearing capacity for cabinets that are floor-supported with a wheeled base will be 1,000 pounds per cabinet. Load bearing capacity will be stated in the manufacturer's product literature.
14. Cabinets that are wall-mount only will be certified and UL Listed to standard UL 60950 under category NWIN. UL Listing will be stated in the manufacturer's product literature.

H. Cable Management Accessories

1. Open Frame Relay Racks
 - a. Vertical: Provide double-sided vertical cable managers with extended fingers on both sides of the rack. Vertical cable managers shall contain cable guides (extended fingers) spaced 1 RU apart allowing front to rear cabling within the manager. Width of cable manager shall be as shown on drawings. Cable manager shall contain a snap-on or hinged cover and extend the full height of the rack.
 - b. Horizontal: Provide horizontal managers at locations shown on drawings. Horizontal managers shall be 3.50" high (2RU) x 19" wide x 6" deep. Horizontal managers shall contain cable guide fingers spaced 1.75" apart with a snap-on or hinged cover.
2. Equipment Cabinets:
 - a. Vertical: Vertical cable management shall be provided on both sides of the mounting rails and located at the front and rear of the cabinet. Vertical cable managers shall contain cable guides (fingers) spaced 1 RU apart.
 - b. Horizontal: Provide horizontal managers at locations shown on drawings. Horizontal managers shall be 3.50" high (2RU) x 19" wide x 6" deep and/or 1.75" high (1RU) x 19" wide x 6" deep as shown on drawings. Horizontal managers shall contain cable guide fingers spaced 1.75" apart with a snap-on or hinged cover.

2.04 POWER DISTRIBUTION UNITS (PDU)

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. APC
2. Raritan (A brand of Legrand)
3. Tripp-Lite
4. Panduit
5. Engineer Approved Equal

B. Horizontal PDU Type 1:

1. Provide horizontal PDU's as shown on the drawings.
2. Mounting: Horizontal PDU shall mount on 19" rack rails. PDU shall require no more than 1RU for mounting.
3. Quantity: See the drawings for the number and type of PDU to provide in each rack and cabinet.
4. Input: 30A, 120VAC, 1-phase. NEMA L5-30P plug type with 15-foot cord.
5. Output: 3KW, 120VAC, 1-phase with (12) 5-15/20R outlets, 120VAC.
6. Overload Protection: (2) 20A circuit breakers protect (6) outlets each
7. Metering: Integral meter displaying input current.
8. UL Listed
9. Basis of Design: Tripp-Lite Model No. PDUMH30

C. Vertical PDU Type 2:

1. Provide vertical PDU's as shown on the drawings.
2. Mounting: Vertical PDU's shall be mounted on the interior side wall of the cabinet or cabinet so as not to interfere with cable routing or prohibit the use of mounting equipment to the rear mounting rails. PDU shall utilize 0 RU when installed.
3. Quantity: See the drawings for the number and type of PDU to provide in each rack and cabinet.
4. Input: 30A, 208VAC, 3-phase. NEMA L21-30P plug type with 15-foot cord.
5. Output: 8.6KW, 120/208VAC, 3-phase. Provide the following outlets:
 - a. (36) C13 Outlets, 208VAC
 - b. (6) C19 Outlets, 208VAC
 - c. (6) NEMA 5-15/20R Outlets, 120VAC
6. Overload Protection: (3) 20A double-pole circuit breakers (1 per output phase)
7. Metering: Integral meter displaying input current per-phase.
8. UL Listed
9. Basis of Design: Tripp-Lite Model No. PDU3MV6L2130

D. Horizontal PDU Type 3:

1. Provide horizontal PDU's as shown on the drawings.
2. Mounting: Horizontal PDU shall mount on 19" rack rails. PDU shall require no more than 2RU for mounting.
3. Quantity: See the drawings for the number and type of PDU to provide in each rack and cabinet.
4. Input: 30A, 208VAC, 3-phase. NEMA L21-30P plug type with 9.84-foot cord.
5. Output: 8.6KW, 120/208VAC, 3-phase. Provide the following outlets:
 - a. (12) C13 Outlets, 208VAC
 - b. (6) C19 Outlets, 208VAC
6. Overload Protection: (3) 20A double-pole circuit breakers (1 per output phase)
7. Metering: Integral meter displaying input current per-phase.
8. UL Listed
9. Basis of Design: Raritan Model No. PX3-1902R

2.05 UPS Unit with SNMP interface

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. APC
 2. CyberPower
 3. Engineer Approved Equal
- B. Description: 2-4 RU high, 3KVA class, Rack Mount Double Conversion Online UPS listed with NRTL.
1. 3 KVA (2.7 KW/2.88KVA).
 2. INPUT: 30A, 120V (NEMA L5-P).
 3. OUTPUT : (6) NEMA 5-15R, (2) NEMA 5-20R, & (1) NEMA L5-30R
- 1) Manufacturer:
- a) APC model Smart-UPS X 3000VA rack/Tower LCD 100-127V. Part Number SMX3KRMLVNCUS

2.06 CABLE RUNWAY

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Chatsworth Products, Inc. – UL Classified Cable Runway
 2. Cooper B-Line – Cable Runway
 3. Engineer Approved Equal
- B. Construction: Cable runway shall be manufactured from 3/8" (9.5 mm) wide by 1-1/2" (38 mm) high tubular steel with .065" (1.65 mm) wall thickness. Cable runway (side stringers) will be 9'-8½" (2959mm) long. Cross members will be welded in between stringers on 9" (230 mm) intervals/centers beginning 4-1/4" (108 mm) from one end.
- C. UL Listed: Cable runway will be UL Classified for suitability as an equipment grounding conductor only (Contractor shall remove paint or use ground straps at splices and intersections).
- D. Sizes: Provide cable runway sizes as defined on drawings.
- E. Finish shall be epoxy-polyester hybrid powder coat (paint) in black, unless noted otherwise.
- F. Connector Assemblies: Turns, transitions, corners and brackets shall meet the same specification as the cable runway section.
- G. Connector Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable runway.
- H. Hardware and Fasteners: Steel, zinc plated matching same color as cable runway section.
- I. Support: Provide a combination of wall mount, data cabinet to cable runway mount, relay rack to cable runway mount and ceiling trapeze cable runway support. The use of a single center hung support rod shall not be allowed.

- J. Grounding: Grounding kits are required to provide a method of bonding cable runway sections and turns together that is independent of the pathway splices. The grounding kit shall be constructed of UL Listed components. The preferred solution is a #6 AWG green insulated stranded copper conductor connected on both ends to ladder rack using two-hole compression lugs and stainless steel hardware.
- K. Accessories: All accessories shall be manufactured from same material as cable runway section. Provide following accessories:
 - 1. Cable straps used for attaching cable bundles to the cable runway cross members must be reusable with a hook and loop-style closure.
 - 2. End caps used to cover the ends of cable runway shall be manufactured from a black fire-retardant rubberized material.
 - 3. End closing kits used to cover the end of cable runway. Kits shall consist of a bar cut to match the width of the cable runway and the hardware required to attach the bar to the end of a length of cable runway.
 - 4. Radius drops used to create a radius to form cables over as the cables exit or enter the cable runway. The extrusion will be formed in a 90° arc with a minimum bend radius of 3" (75 mm). Radius drops will attach to either the side stringer or the cross member of the cable runway using a clevis pin. Provide radius drops at all sections where cable exits runway

2.07 LABELING

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3: EXECUTION

3.01 ENTRANCE FACILITIES

- A. Comply with requirements in Section 270528 "Pathways for Communications Systems" for materials and installation requirements for underground pathways.

3.02 INSTALLATION

- A. Comply with NECA 1.
- B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.
- C. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- D. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
 - 1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
 - 2. Record agreements reached in meetings and distribute them to other participants.

- 3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of LAN equipment.
 - 4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.
- E. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.03 FIRESTOPPING

- A. Comply with requirements in Section 270528 "Pathways for Communications Systems" for fire rated pathways.
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.04 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements noted elsewhere in Division 27 for specific labeling requirements.
- B. Labels shall be preprinted or computer-printed type. Provide self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designators.

END OF SECTION 27 11 00

SECTION 27 13 23 - COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

PART 1: GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Provide work specified but not shown on Drawings, and work shown on Drawings but not specified, as though expressly required by both.

1.02 SUMMARY

- A. Section Includes:
 - 1. 9/125 micrometer single-mode, armored, indoor optical fiber cable (OS2).
 - 2. Optical fiber cable connecting hardware, patch panels, and patch cords.
 - 3. Cabling identification products.

1.03 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. LAN: Local area network.
- D. RCDD: Registered Communications Distribution Designer.
- E. APC: Angled Physical Contact
- F. UPC: Ultra Physical Contact

1.04 OPTICAL FIBER BACKBONE CABLING DESCRIPTION

- A. Optical fiber backbone cabling system shall provide interconnections between communications equipment rooms and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, patch panels, connectors, and patch cords or jumpers used for backbone-to-backbone cross-connection.
- B. Backbone cabling cross-connections may be located in communications equipment rooms or at entrance facilities.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: Reviewed and stamped by RCDD.
 - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 - 2. Floor Plans: that identify device locations, cable routes and quantities, cable types, riser locations, and references to installation details and diagrams.
 - 3. Diagrams/Elevations: showing room layouts, rack layouts (including elevations), riser layouts, etc.
- C. Fiber optic cable testing plan.

1.06 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For RCDD.
- B. Source quality-control reports.
- C. Field quality-control reports.

1.07 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For optical fiber cable, splices, and connectors to include in maintenance manuals.

1.08 WARRANTY

- A. Period: The Contractor shall warranty all labor, workmanship, and materials for a period of one (1) year from the date of final Owner acceptance. Should a failure occur within this warranty period, the Contractor shall provide all labor and materials necessary to restore the system to the condition required for the final test and acceptance for this contract, at no cost to the Owner.
- B. Extended Warranty: The manufacturer shall guarantee in writing that the optical fiber backbone cable channels as installed by this contract are free from defects in materials and workmanship and will meet the applicable ANSI/TIA/EIA and ISO/IEC channel transmission requirements in effect at the time of installation and will support any current or future application ratified by IEEE, ANSI, or ISO designed to operate over the applicable ANSI/TIA/EIA-568-B and ISO/IEC 11801 standards in effect at the time of installation. The duration of this warranty shall be for a period of 25 years from date of final Owner acceptance. Defective products shall be repaired or replaced by the manufacturer, at no cost to the Owner.

1.09 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling installer must be a certified installer meeting all requirements for the cable manufacturer's 25 year warranty program and must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings by an RCDD.
 - 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.

1.11 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.12 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with all other trades and service providers, if applicable.

PART 2: PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. General Performance: Backbone cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.
- B. Surface-Burning Characteristics: Flame spread shall not exceed 5 ft (1.5 m) when tested in accordance with NFPA 262.
- C. Telecommunications Pathways and Spaces: Comply with TIA-569-D.
- D. Grounding: Comply with TIA-607-B.

2.02 9/125 MICROMETER SINGLE-MODE, INDOOR OPTICAL FIBER CABLE (OS1)

- A. Description: Single mode, 9/125-micrometer, tight-buffered, optical fiber cable. Refer to drawings for strand count.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Belden CDT Networking Division/NORDX.
 - 2. Corning Cable Systems.
 - 3. General Cable; General Cable Corporation.
 - 4. Mohawk; a division of Belden Networking, Inc.
 - 5. Superior Essex Inc.
 - 6. Berk-Tek; a division of Leviton Company
 - 7. Engineer Approved Equal
- C. Standards:

1. Comply with TIA-492CAAB for detailed specifications.
 2. Comply with TIA-568-C.3 for performance specifications.
 3. Comply with ICEA S-83-596 for mechanical properties.
- D. General: Fiber optic cable construction shall consist of 8.3 μm single mode optical fibers typically formed in groups of six (6) or twelve (12) fibers each. Size, strand count and routing of fiber optic cables shall be as indicated on the drawings. These groups and individual fibers shall exceed all requirements for ANSI/TIA/EIA-568-B.3 and support high speed communication network applications. These groups assembled to form a single compact core, which is covered by a protective sheath.
- E. Optical Fiber Requirements and Performance:
1. Core Diameter: 8.3 μm
 2. Cladding Diameter: 125 $\mu\text{m} \pm 1\mu\text{m}$
 3. Cladding Non-Circularity: $\leq 1\%$
 4. Core/Cladding Concentricity Error: 0.5 μm
 5. Colored Fiber Diameter: 254 $\mu\text{m} \pm 7\mu\text{m}$
 6. Minimum Bandwidth: 20GHz
 7. Maximum Attenuation:
 - a. 1310nm ≤ 0.65 dB/km
 - b. 1550nm ≤ 0.50 dB/km
- F. Design Specifications: Provide cable suitable for installation in indoor (plenum) environments with tight-buffered cables surrounded by an overall cable jacket. Cable jacket shall meet the following specification:
1. Jacket Color: Yellow.
 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).
 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - a. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
- G. Single-mode (Dispersion Un-shifted): All single-mode fiber shall support 10 Gigabit Ethernet (10 Gbps) to distances of up to 10,000 meters @ 1310 nm and 40,000 meters @ 1550 nm per IEEE 802.3 performance. The single-mode fiber utilized in the optical fiber cable shall meet TIA-492CAAB, "Detail Specification for Class Iva Dispersion-Unshifted Single-Mode Optical Fibers with Low Water Peak," and ITU recommendation G.652 "Characteristics of a single-mode optical fiber cable."
- H. Identification: The individual fibers shall be color coded for identification. The optical fiber color coding shall be in accordance with EIA/TIA-598, "Optical Fiber Cable Color Coding." When buffered fibers are grouped into individual subunits, each subunit jacket shall be numbered for identification, with the exception of filler subunits where used. The outer jacket shall be marked with the manufacturer's name or ETL file number, date of manufacture, fiber count, fiber type, flame rating, listing symbol, and sequential length markings every two feet.

2.03 9/125 MICROMETER SINGLE-MODE, INDOOR-OUTDOOR OPTICAL FIBER CABLE (OS1)

- A. Description: Single mode, 9/125-micrometer, tight-buffered, optical fiber cable. Refer to drawings for strand count.
1. Refer to drawings and elsewhere in these specifications where armored optical fiber cables are required.

- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Belden CDT Networking Division/NORDX.
 2. Corning Cable Systems.
 3. General Cable; General Cable Corporation.
 4. Mohawk; a division of Belden Networking, Inc.
 5. Superior Essex Inc.
 6. Engineer Approved Equal
- C. Standards:
1. Comply with TIA-492CAAB for detailed specifications.
 2. Comply with TIA-568-C.3 for performance specifications.
 3. Comply with ICEA S-104-696 for mechanical properties.
- D. Armored cable (where required) shall be aluminum armored type.
- E. General: Fiber optic cable construction shall consist of 8.3 μm single mode optical fibers typically formed in groups of six (6) or twelve (12) fibers each. Size, strand count and routing of fiber optic cables shall be as indicated on the drawings. These groups and individual fibers shall exceed all requirements for ANSI/TIA/EIA-568-B.3 and support high speed communication network applications. These groups assembled to form a single compact core, which is covered by a protective sheath.
- F. Optical Fiber Requirements and Performance:
1. Core Diameter: 8.3 μm
 2. Cladding Diameter: 125 $\mu\text{m} \pm 1\mu\text{m}$
 3. Cladding Non-Circularity: $\leq 1\%$
 4. Core/Cladding Concentricity Error: 0.5 μm
 5. Colored Fiber Diameter: 254 $\mu\text{m} \pm 7\mu\text{m}$
 6. Minimum Bandwidth: 20GHz
 7. Maximum Attenuation:
 - a. 1310nm $\leq 0.65 \text{ dB/km}$
 - b. 1550nm $\leq 0.50 \text{ dB/km}$
- G. Design Specifications: Provide cable suitable for installation in indoor (plenum) environments with tight-buffered cables surrounded by an interlocking armor. Cable jacket shall meet the following specification:
1. Jacket Color: Yellow.
 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).
 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - a. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
 - b. Plenum Rated, Armored (Conductive): Type OFCP, complying with NFPA 262.
 5. Armor Material (where required): The armor material shall be constructed of aluminum interlocking armor. The armor of each optical cable shall be bonded to the ground busbar located in the rack. An additional outer jacket shall be placed over the armor. The color of the armor jacket shall match the jacket color of the optical fiber cable located inside of the armor.
- H. Single-mode (Dispersion Un-shifted): All single-mode fiber shall support 10 Gigabit Ethernet (10 Gbps) to distances of up to 10,000 meters @ 1310 nm and 40,000 meters @ 1550 nm per IEEE 802.3 performance. The single-mode fiber utilized in the optical fiber cable shall meet TIA-

492CAAB, "Detail Specification for Class Iva Dispersion-Unshifted Single-Mode Optical Fibers with Low Water Peak," and ITU recommendation G.652 "Characteristics of a single-mode optical fiber cable."

- I. Identification: The individual fibers shall be color coded for identification. The optical fiber color coding shall be in accordance with EIA/TIA-598, "Optical Fiber Cable Color Coding." When buffered fibers are grouped into individual subunits, each subunit jacket shall be numbered for identification, with the exception of filler subunits where used. The outer jacket shall be marked with the manufacturer's name or ETL file number, date of manufacture, fiber count, fiber type, flame rating, listing symbol, and sequential length markings every two feet.

2.04 OPTICAL FIBER CABLE HARDWARE AND PATCH CORDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Belden CDT Networking Division/NORDX.
 - 2. Corning Cable Systems.
 - 3. Hubbell Premise Wiring.
 - 4. Optical Cable Corporation.
 - 5. Engineer Approved Equal
- B. Patch Panel Housings
 - 1. Fiber Optic housings shall provide a means for securing, strain-relieving, protecting, and labeling of fiber optic cable terminations.
 - 2. Rack-Mount Housing Specifications
 - a. Housings shall be designed for rack-mounted or frame-mounted applications that support conventional cross-connection and interconnection schemes as well as splicing applications.
 - b. Housings shall be available in 1U, 2U, 3U and 4U. See drawings for exact size of housings.
 - 3. The housings shall meet the design requirements of ANSI/TIA/EIA-598 and the plastics flammability requirements of UL 94 V-0.
 - 4. The connector housings shall have a labeling scheme that complies with ANSI/TIA/EIA-606.
 - 5. The housings shall support cross-connection, inter-connection and/or splicing applications and routing schemes in the same housing.
 - 6. The housing shall contain a front compartment whose function is to protect and manage jumpers that interface with the main housing behind it. The front jumper assembly compartment shall be removable and be accessible via a translucent door.
 - 7. The front compartment shall contain jumper egress openings on both sides that are edged with protective pass-through grommets that provide bend radius support for optical fiber jumpers.
 - 8. The rear assembly housing shall be accessible via a hinged door. The door shall contain a routing and cable sub-unit slack storage bracket for interior management of cable sub-units and buffer tubes.
 - 9. The housing shall contain a brushed entry on both sides of the rear of the housing.
 - 10. The housing shall provide means for strain-relieving fiber optic cables both interior to and exterior on the rear assembly housing.
 - 11. The rear of the housing shall contain provisions for routing and maintaining fiber optic cable components, including cable sub-units and buffer tube, 900 um optical fiber, and buffer tube transition kits.
 - 12. The floor/base of the rear of the housing shall provide holes or slots for the installation (and removal) of fiber retention or slack management clips.

13. The floor/base of the rear assembly housing shall provide holes or slots for the installation (and removal) of transitional strain-relief clips.
- C. Wall Mount Single-Panel Housing
1. The single-panel housing shall provide a base enclosure with a front (main) door, and back-plate, as well as top and bottom cable entries.
 2. The housing shall provide necessary protection from incidental contact, dust and debris.
 3. The housing shall be fully accessible from the front and sides (either left or right depending on mounting orientation of the housing).
 4. The housing shall provide all necessary provisions for proper management and administration of optical fiber, fiber optic connectors, splices, cable-subunits, transition kits and other related components.
 5. The single-panel housing shall support cross-connection, inter-connection and/or splicing applications and routing schemes in the same housing.
 6. The housing shall accommodate direct connector installations or terminations via connector panels. Connector panels shall be held in place via push-pull plungers that are affixed to the housing itself.
 7. The housing shall be capable of holding up to one (1) connector panel that loads directly into the side of the housing.
 8. The housing shall accommodate pigtail splicing via an internal splice organizer with pigtailed connector panels.
 9. The front or main entry of the housing and interior shall be accessible via a solid metal door. The rear or base of the housing shall be accessible via a solid metal back-plate.
 10. The housing shall contain openings on both the top and bottom sides of it that allow fiber optic cables to enter the housing in either a through or mid-span configuration. The housing shall provide means for strain-relieving fiber optic cables inside the housing.
 11. The housing's interior shall contain provisions for routing and maintaining fiber optic cable components, including cable sub-units and buffer tubes, 900 μm optical fiber, and buffer tube transition kits.
 12. The housing's base shall incorporate pre-stamped metal lances for affixing a splice organizer capable of holding 12 to 24 fiber optic splice protectors.
 13. Installation of the adapter or connector panel (including loaded connector pigtails) shall not interfere with the internal cable sub-unit routing.
 14. The base of the housing, following removal of the back-plate, shall contain corner openings that allow cable sub-units to route between housings in a stacked configuration.
 15. Wall-mountable connector housings shall accept an interchangeable connector panel. The connector panel shall have the following characteristics:
 - a. The connector panel shall utilize a single mounting footprint and shall be available with various connector adapters and different adapter counts in each panel.
 - b. The connector panel shall be interchangeable between the rack and wall-mountable hardware being proposed.
 - c. The panel shall be attached to the housing or splice or slack storage cassette with latches to allow quick installation and removal.
- D. Fiber Optic Adapter Panels
1. Rack and wall mountable connector housings shall accept an interchangeable connector panel.
 2. The adapter panel shall utilize a single mounting footprint and shall be interchangeable between the rack and wall mountable hardware used.
 3. The panel shall be attached with two push-pull latches to allow quick installation and removal.
 4. The adapter panel shall be available with industry standard single fiber and small form factor multi-fiber adapters, including the SC duplex, LC duplex and MPO.
 5. The adapter panel shall accommodate optical fiber.
 6. Pigtailed panel shall consist of an adapter panel as described above, factory-loaded with factory-terminated pigtails, 3 m in length.

7. Blank adapter panels shall be available to fill unused space within housings. Housings shall be supplied with blank adapter panels for all available positions unless the housing is ordered with optical fiber adapters panels pre-installed. The blank panel shall be attached with at least two spring clips to allow quick installation and removal.
- E. Fiber Optic Splice Cassettes
1. Rack mountable housings shall accept an interchangeable splice cassette.
 2. The splice cassette shall consist of a base constructed from injection-molded black plastic and a removable hinged lid or cover constructed from injection-molded translucent plastic.
 3. The splice cassette shall be available with pre-installed connector pigtails and panels.
 4. The splice cassette shall allow one connector panel to be installed into the base.
 5. The splice cassette shall be able to hold and contain at least one meter of pigtail fiber slack on the interior floor of the base.
 6. The splice cassette shall be able to hold and contain up to one meter of 2.0-3.0 mm buffer tube slack or jacketed pigtail slack (up to 24 fiber) on the exterior bottom of the base.
 7. The splice cassette shall contain a pivoting (and removable) splice tray above the base in a horizontal position that rotates up into a vertical position at least 90 degrees relative to the base allowing access to the base.
 8. The splice tray shall contain one interchangeable splice organizer capable of holding up to (24) splice heat-shrinks, routing tabs and provisions for holding a total of two meters of 250 or 900 micron fiber slack and contain slots and provisions for installing cable ties for securing incoming and outgoing buffer tubes and/or jacketed optical fibers.
 9. The splice cassette shall contain relief slots for holding up to two buffer tube transition ("fan-out") kits on either side of the base.
 10. The splice cassette shall contain two fiber retention tabs behind the connector panel location to maintain fiber below the connections and adapters in an installed connector panel.
 11. Refer to rack elevation drawings for required Fiber Optic Splice Cassette types.
- F. Multi-fiber Push On (MPO) Trunk Connectors
1. The optical fiber backbone cabling system shall utilize a modular solution consisting of factory-terminated trunk assemblies utilizing 12-fiber MPO array connectors, MPO to LC Duplex modules and jumpers, and MPO adapter panels and harnesses.
 2. MPO to MPO High-Density Trunk Assemblies:
 - a. Trunks shall be all-dielectric construction.
 - b. Trunks shall be terminated with MPO connectors at both ends, having 12 fibers per ferrule.
 - c. Jacket color and break-out leg jacket color shall be yellow for single-mode fiber assemblies.
 - d. MPO -terminated primary trunks shall have non-pinned MPO connectors on both ends.
 - e. MPO -terminated extender trunks shall have pinned MPO connectors on the end to be interconnected with a primary trunk and non-pinned MPO connectors on the other end.
 - f. The trunk assemblies shall be available in 12, 24, 36, 48, 72, 96, and 144-fiber counts; specific fiber counts to be used shall be specified on the drawings.
 - g. Trunks shall be furcated into 12-fiber legs (subunits). Standard leg length shall be 33 in +3/-0 in.
 - h. Trunk length shall be the distance between furcation points at each end of the cable and shall not be inclusive of the length of the legs at each end.
 - i. Trunk furcation plugs shall incorporate mechanically designed features that allow securing the trunks inside or outside a connector housing.
 - j. The trunk shall incorporate a flexible boot at the back of the epoxy plug, in order to provide a uniformly smooth transition between the plug and the trunk cable.
 - k. The trunk cable shall have a minimum bend radius of five times the cable outside diameter.

- l. Trunks shall meet the connector performance specifications of TIA/EIA-568-C.3, Optical Fiber Cabling Components Standard, (normative) Annex A.
 - m. Manufacturer shall have a field installable MPO connector offering (to support capabilities to field repair). The field installable MPO connector shall be a no epoxy/no polish style connector.
 - n. Contractor shall field verify the type and lengths of MPO trunk cables, prior to placing order.
- 3. MPO to LC High-Density Modules (Cassettes)
 - a. Modules shall contain 12 fiber terminations with one 12-fiber cable assembly within a protective housing. Cable assemblies within the modules shall be terminated with an MPO pinned connector at the back and LC connectors at the front.
 - b. Modules shall have shuttered LC adapters at the front, with a shutter door that opens inward. Module shall have self-retracting shutter adapter mechanism that allows a single hand operation. The shutter shall be translucent and shall be VFL compatible.
 - c. Modules shall permit front and rear installation into the patch panel housings.
 - d. Modules shall contain discrete fiber and port identification. This fiber and port identification shall be pad printed on top and bottom of the modules.
- G. Port Breakout Modules (Cassettes)
 - 1. Port breakout modules enable conversion from a single 4-channel parallel optic port (such as 40GSR4 (QSFP), to a patch panel representation with four LC duplex ports.
 - 2. MTP tail shall connect to the active electronics and breakout the 8-fiber QSFP 40G transceiver into 4 x 2-fiber 10G LC duplex connections.
 - 3. Breaks out 8-fiber MTP terminations from the rear into 4 x LC duplex connectivity at the front.
 - 4. 0.60 dB (Max.) module insertion loss.
 - 5. Internal wiring (universal polarity) ensures correct fiber polarity.
 - 6. LC duplex adapters with translucent inward-folding shutters.
 - 7. Port breakout module assembly includes single-mode ultra-fiber, 4-LC Duplex shuttered adapters (blue) on front, 10 foot plenum rated, bend-improved single-mode (OS2) fiber interconnect tail on rear terminated with 8F MTP (non-pinned), Type B, (MTP blue to the left), Universal Polarity (LCs).
 - 8. Basis of Design: Corning model no. ECM8-04E8-GE8B-010F
- H. Fiber Optic Patch Cords:
 - 1. Single-mode, duplex fiber patch cable shall be LC-LC, yellow.
 - 2. The single-mode, duplex fiber patch cable shall consist of 9 micron core and a 125 micron cladding. The fiber cladding shall be covered by aramid yarn and OFNR rated, unless otherwise indicated on the drawings.
 - 3. Contractor shall field verify the type and lengths of patch cables, prior to placing order.
 - 4. Contractor shall provide all patch cords required to perform the patching as designated on the contract drawings and specifications. Provide one (1) patch cord for each terminated fiber port at both ends. All slack in the patch cords shall be appropriately dressed using vertical and horizontal patch cord organizers to maintain a neat appearance.
 - 5. Fiber optic patch cords shall be manufactured and certified by the same manufacturer of the permanent link cabling.
- I. UPC Fiber Optic Connector:
 - 1. LC, Single-mode, UPC, ceramic ferrule, field installable, blue housing, blue boot, pre-polished connector.

2. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA-604-2-B for Type LC connectors and TIA-604-5-D for Type MPO connectors. Comply with TIA-568-C.3.
3. Quick-connect, duplex, Type LC connectors. Insertion loss not more than 0.25 dB.

J. APC Fiber Optic Connector:

1. SC, Single-mode, APC, ceramic ferrule, field installable, blue housing, blue boot, pre-polished connector.
2. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA-604-2-B for Type SC connectors. Comply with TIA-568-C.3.
3. Quick-connect, simplex, Type SC connectors. Insertion loss not more than 0.25 dB.
4. Angled polished connectors shall be used for Boingo Distributed Antenna Systems (DAS) connectivity.

2.05 GROUNDING

- A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
- B. Comply with TIA-607-B.

2.06 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.07 SOURCE QUALITY CONTROL

- A. Factory test optical fiber cables according to TIA-526-14-B and TIA-568-C.3.
- B. Factory test pre-terminated optical fiber cable assemblies according to TIA-526-14-B and TIA-568-C.3.
- C. Cable will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3: EXECUTION

3.01 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 2. Comply with requirements for pathways specified in Section 270528 "Pathways for Communications Systems."

- B. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to termination points without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.02 INSTALLATION OF OPTICAL FIBER BACKBONE CABLES

- A. Comply with NECA 301.
- B. General Requirements for Cabling:
 - 1. Comply with TIA-568-C.1 and TIA-568-C.3.
 - 2. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."
 - 3. Terminate and test all cables; no cable shall contain unterminated elements. Make terminations only at indicated patch panels.
 - 4. Cables may not be spliced. Secure and support cables at intervals not exceeding 36 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 - 6. Bundle, lace, and train cable to termination points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
 - 7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination points. Remove and discard cable if damaged during installation and replace it with new cable.
 - 8. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.
 - 9. In the communications equipment room, install a 10-foot (3-m) long service loop on each end of cable.
 - 10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
 - 11. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
- C. Open-Cable Installation:
 - 1. Install cabling with horizontal and vertical cable guides in communications equipment rooms with terminating hardware and interconnection equipment.
 - 2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- D. Group connecting hardware for cables into separate logical fields.

3.03 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.04 GROUNDING

- A. Shields/armors shall be grounded according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with TIA-607-B and NECA/BICSI-607.
- C. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.05 IDENTIFICATION

- A. Cable Management Software: This contractor shall be responsible for updating the existing airport cable management software program with all communication optical fiber backbone cables installed as part of this project.
- B. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- C. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- D. Cable and Wire Identification:
 - 1. Label each cable within 4 inches (100 mm) of each termination, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Label each unit and field within distribution racks and frames.
 - 3. Identification within patch panels in communication equipment rooms: Label each connector and each discrete unit of cable-terminating and connecting hardware.
- E. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606-B, for the following:
 - 1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.06 FIELD QUALITY CONTROL AND TESTING

- A. General:
 - 1. This Section includes the minimum requirements for the test certification, identification and administration of backbone and horizontal optical fiber cabling.
 - 2. This Section includes minimum requirements for:
 - a. Fiber optic test instruments
 - b. Fiber optic testing
 - c. Administration
 - d. Test results documentation
 - 3. Testing shall be carried out in accordance with this document. This includes testing the attenuation and polarity of the installed cable plant with an optical loss test set (OLTS). In

addition to OLTS testing the optical fiber cabling may require testing with an optical time domain reflectometer (OTDR), this is defined elsewhere in this section.

4. All tests shall be documented including OLTS dual wavelength attenuation measurements and OTDR traces with event tables as well as OTDR maps where OTDR testing is required.

B. Requirements:

1. All testing procedures and field-test instruments shall comply with the latest version and applicable requirements of ANSI/TIA/EIA standards addressing the testing and administration of optical fiber cabling.
2. Trained technicians who have successfully attended an appropriate training program, which includes testing with an OLTS and an OTDR and have obtained a certificate as proof thereof shall execute the tests.
3. The Owner or the Owner's representative shall be invited to witness field-testing.
 - a. The Owner or the Owner's representative shall be notified of the start date of the testing phase five (5) business days before testing commences.
4. Manufacturers catalog sheets and specifications for fiber optic field-test instruments including optical loss test sets (OLTS; power meter and source) and optical time domain reflectometer (OTDR), if required.
5. A schedule (list) of all optical fibers to be tested.
6. Sample test reports.

C. Test Limits and Parameters

1. Unless otherwise specified by the Owner or the Owners representative, each cabling link shall be in compliance with the following test limits:
 - a. Optical Loss Testing
 - 1) Multimode and Singlemode links: The link attenuation shall be calculated by the following formulas as specified in ANSI/TIA-568-C.0.
 - a) $\text{Link\_Attenuation (dB)} = \text{Cable\_Attn (dB)} + \text{Connector\_Attn (dB)} + \text{Splice\_Attn (dB)}$
 - b) $\text{Cable\_Attn (dB)} = \text{Attenuation\_Coefficient (dB/km)} * \text{Length (Km)}$
 - c) $\text{Connector\_Attn (dB)} = \text{number\_of\_connector\_pairs} * \text{connector\_loss (dB)}$
 - d) Maximum allowable connector_loss = 0.75 dB
 - e) $\text{Splice\_Attn (dB)} = \text{number\_of\_splices} * \text{splice\_loss (dB)}$
 - f) Maximum allowable splice_loss = 0.3 dB
 - g) The values for the Attenuation_Coefficient (dB/km) are listed in the table below:

Type of Optical Fiber	Wavelength (nm)	Attenuation coefficient (dB/km)	Wavelength (nm)	Attenuation coefficient (dB/km)
Multimode 62.5/125 μm	850	3.5	1300	1.5
Multimode 50/125 μm	850	3.5	1300	1.5

Single-mode (Inside plant)	1310	1.0	1550	1.0
Single-mode (Outside plant)	1310	0.5	1550	0.5

2. OTDR Testing

- a. In addition to OLTS testing, OTDR testing shall be required for optical fiber cabling containing a splice within the link length of the cable run. Splices made to connect break-out kits and pig tails are not required to be tested by an OTDR.
- b. Reflective events (connections) shall not exceed:
 - 1) 0.75 dB in optical loss when bi-directionally averaged
 - 2) -35 dB Reflectance for multimode connections
 - 3) -40 dB reflectance for UPC singlemode connections
 - 4) -55 dB reflectance for APC singlemode connections
- c. Non-reflective events (splices) shall not exceed 0.3 dB.

3. All installed cabling links and channels shall be field-tested and pass the test requirements and analysis as described under Optical Fiber Cable Testing section of this specification. Any link or channel that fails these requirements shall be diagnosed and corrected. Any corrective action that must take place shall be documented and followed with a new test to prove that the corrected link or channel meets performance requirements. The final and passing result of the tests for all links and channels shall be provided in the test results documentation in accordance with the Optical Fiber Cable Testing section of this specification.
4. Acceptance of the test results shall be given in writing after the project is fully completed and tested in accordance with Contract Documents and to the satisfaction of the Owner.

D. Testing Equipment:

1. The field-test instrument shall be within the calibration period recommended by the manufacturer and a copy of the calibration certificate made available.
2. Acceptable manufacturers
 - a. Fluke Networks
 - b. Tektronix
 - c. Engineer Approved Equal

E. Test Records:

1. Administration of the documentation shall include test results of each fiber link and channel.
2. The test result information for each link shall be recorded in the memory of the field-test instrument upon completion of the test.
3. The test result records saved within the field-test instrument shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of these test records.

F. Optical Fiber Testing

1. Field-test instruments shall have the latest software and firmware installed.

2. Testing shall be performed on each cabling link (connector to connector).
3. Testing shall be performed on each cabling channel (equipment to equipment) as identified in the contract documents.
 - a. Testing shall not include any active devices or passive devices within the link or channel other than cable, connectors, and splices, i.e. link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.
4. Testing of the cabling shall be performed using high-quality test reference cords of the same core size as the cabling under test, terminated with reference grade connectors. Reference grade connectors are defined as having a loss not exceeding 0.1 dB for multimode and 0.2 dB for singlemode.
5. OLTS Testing
 - a. Horizontal/Backbone link
 - 1) Multimode links shall be tested in one direction at 850 nm and 1300 nm in accordance with ANSI/TIA-526-14-B, one-cord reference method, with an Encircled Flux compliant launch.
 - 2) Singlemode backbone links shall be tested in one direction at 1310 nm and 1550 nm in accordance with ANSI/TIA/EIA-526-7, Method A.1 (One-cord reference method).
 - 3) Link attenuation does not include any active devices or passive devices other than cable, connectors, and splices, i.e. link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.
6. OTDR Testing
 - a. Fiber links shall be tested at these wavelengths for anomalies and to ensure uniformity of cable attenuation, connector insertion loss and reflectance.
 - 1) Multimode: 850 nm and 1300 nm.
 - 2) Singlemode: 1310 nm and 1550 nm.
 - b. Each fiber link and channel shall be tested in both directions.
 - 1) The launch and tail fibers shall remain in place for the measurement in the opposite direction – failing to do so will result in an increase in measurement uncertainty.
 - 2) The use of a loop back fiber at the far end with a tail fiber at the near end on the adjacent fiber is permitted for bi-directional testing, so long as the OTDR is able to split the trace automatically into two traces for the two fibers under test.
 - c. A launch cable shall be installed between the OTDR and the first link connection.
 - d. A tail cable shall be installed after the last link connection.
7. Length Measurement
 - a. The optical length of each fiber shall be recorded using an OLTS or OTDR.
8. Polarity Testing
 - a. Paired duplex fibers in multi-fiber cables shall be tested to verify polarity in accordance with Clause E.5.3 of ANSI/TIA 568 C.0. The polarity of the paired duplex fibers shall be verified using an OLTS.

G. Administration

1. Test results documentation

- a. The test results documentation shall be available for inspection by the Owner or the Owner's representative during the installation period and shall be passed to the Owner's representative within 5 working days of completion of tests.
- b. The database for the complete project shall be stored and delivered on CD/DVD prior to Owner acceptance of the building in the original format used by the cabling vendors' software.
- c. Circuit IDs reported by the test instrument should match the cable label ID.
- d. The detailed test results documentation data is to be provided in an electronic database for each tested optical fiber and shall contain the following information
 - 1) The identification of the customer site as specified by the end-user.
 - 2) The name of the test limit selected to execute the stored test results.
 - 3) The name of the personnel performing the test.
 - 4) The date and time the test results were saved in the memory of the tester.
 - 5) The manufacturer, model and serial number of the field-test instrument.
 - 6) The version of the test software and the version of the test limit database held within the test instrument.
 - 7) The fiber identification number.
 - 8) The length for each optical fiber.
 - 9) The index of refraction used for length calculation when using length capable OLTS.
 - 10) The backscatter coefficient of the fiber under test when using an OTDR.
 - 11) Test results to include OLTS attenuation link and channel measurements at the appropriate wavelength(s) and the margin (difference between the measured attenuation and the test limit value).
 - 12) Test results to include OTDR link and channel traces, event tables at the appropriate wavelength(s) and a map of the link tested.
 - 13) The length for each optical fiber as calculated by the OTDR.
 - 14) The overall Pass/Fail evaluation of the link-under-test for OLTS and OTDR measurements

END OF SECTION 27 13 23

SECTION 27 15 13 - COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1: GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Provide work specified but not shown on Drawings, and work shown on Drawings but not specified, as though expressly required by both.

1.02 SUMMARY

- A. Section Includes:
 - 1. Category 6 and Category 6a twisted pair cable.
 - 2. Twisted pair cable hardware, including plugs and jacks.
 - 3. Surge Protectors
 - 4. Cabling identification products.
 - 5. Grounding provisions for twisted pair cable.
 - 6. Source quality control requirements for twisted pair cable.
- B. Related Requirements:
 - 1. Section 280513 "Conductors and Cables for Electronic Safety and Security" for data cabling associated with system panels and devices.

1.03 DEFINITIONS

- A. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- B. EMI: Electromagnetic interference.
- C. IDC: Insulation displacement connector.
- D. LAN: Local area network.
- E. Jack: Also commonly called an "outlet," it is the fixed, female connector.
- F. Plug: Also commonly called a "connector," it is the removable, male telecommunications connector.
- G. RCDD: Registered Communications Distribution Designer.
- H. UTP: Unscreened (unshielded) twisted pair.

1.04 COPPER HORIZONTAL CABLING DESCRIPTION

- A. Copper horizontal cabling system shall provide interconnections between communications equipment room and the equipment outlet. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords used for horizontal-to-horizontal cross-connection.
 - 1. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
 - 2. Bridged taps and splices shall not be installed in the horizontal cabling.
- B. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment and 16 feet (4.9 m) in the horizontal cross-connect.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Reviewed and stamped by RCDD.
 - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 - 2. Floor Plans: that identify device locations, cable routes and quantities, cable types, riser locations, and references to installation details and diagrams.
 - 3. Diagrams/Elevations: showing room layouts, rack layouts (including elevations), riser layouts, etc.
- C. Copper horizontal cable testing plan.

1.06 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For RCDD.
- B. Source quality-control reports.
- C. Field quality-control reports.

1.07 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For splices, patch panels and connectors to include in maintenance manuals.

1.08 WARRANTY

- A. Period: The Contractor shall warranty all labor, workmanship, and materials for a period of one (1) year from the date of final Owner acceptance. Should a failure occur within this warranty period, the Contractor shall provide all labor and materials necessary to restore the system to the condition required for the final test and acceptance for this contract, at no cost to the Owner.
- B. Extended Warranty: The manufacturer shall guarantee in writing that the copper horizontal cable channels as installed by this contract are free from defects in materials and workmanship and will

meet the applicable ANSI/TIA/EIA and ISO/IEC channel transmission requirements in effect at the time of installation and will support any current or future application ratified by IEEE, ANSI, or ISO designed to operate over the applicable ANSI/TIA/EIA-568-B and ISO/IEC 11801 standards in effect at the time of installation. The duration of this warranty shall be for a period of 25 years from date of final Owner acceptance. Defective products shall be repaired or replaced by the manufacturer, at no cost to the Owner.

1.09 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling installer must be a certified installer meeting all requirements for the cable manufacturer's 25 year warranty program and must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings by an RCDD.
 - 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test each pair of twisted pair cable for open and short circuits.

1.11 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.12 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with all other trades, Owner's LAN equipment suppliers and service providers, if applicable.

PART 2: PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.
- B. Surface-Burning Characteristics: Flame spread shall not exceed 5 ft (1.5 m) when tested in accordance with NFPA 262.
- C. Telecommunications Pathways and Spaces: Comply with TIA-569-D.
- D. Grounding: Comply with TIA-607-B.

2.02 GENERAL CABLE CHARACTERISTICS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:
 - 1. Communications, Plenum Rated: Type CMP complying with UL 910.
- B. RoHS compliant.

2.03 CATEGORY 6 TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6 cable at frequencies up to 350MHz.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. AMP NETCONNECT; a TE Connectivity Ltd. company.
 - 2. Belden CDT Networking Division/NORDX.
 - 3. Berk-Tek Leviton; a Nexans/Leviton alliance.
 - 4. CommScope, Inc.
 - 5. General Cable; General Cable Corporation.
 - 6. Mohawk; a division of Belden Networking, Inc.
 - 7. Superior Essex Inc.
 - 8. Engineer Approved Equal
- C. General Performance Specifications: The minimum requirements for Category 6 cables shall conform to TIA/EIA 568B Commercial Building Telecommunications Cabling Standard, Horizontal Cable Section. Application standards supported should include, but not limited to:
 - 1. 10Base-T through 1GBase-T Ethernet
 - 2. Power over Ethernet (Poe & PoE+)
 - 3. 155Mb/s ATM and token ring
 - 4. 550MHz Broadband Video
 - 5. Backwards compatible to legacy protocols and applications.
- D. General Design Specifications: Indoor horizontal cable shall be plenum, Category 6, Unshielded Twisted Pair (UTP) composed of 23 AWG bare solid-copper conductors, insulated (FEP). The insulated conductors are twisted into pairs and sheathed with a low smoke PVC jacket. Cable shall be classified as a Category 6 cable meeting the following minimum design specifications:
 - 1. Pair Count: 4
 - 2. Conductor: Solid annealed copper 23 AWG
 - 3. Insulation CMP: FEP
 - 4. Separator: Full Cross-web
 - 5. Jacket CMP: FR, low smoke PVC, blue in color, confirm exact color before ordering.
 - 6. Impedance: $100\Omega \pm 15$
 - 7. Velocity of Propagation: CMP: 72%
 - 8. Performance Compliance: UL 444, UL 1666, NFPA 262, ANSI/TIA-568-C.2, Article 800, NEC (NFPA 70)
 - 9. NRTL Programs: UL Verified CAT 6, UL Listed CMP-LP (0.6)
 - 10. Standard: Comply with TIA-568-C.2 for Category 6 cables.

- E. Outdoor Rated Category 6 Cable: outdoor rated Category 6 cable shall meet all performance requirements as specified for indoor/interior Category 6 cable. In addition, the inner construction of the cable shall be surrounded by a filling compound to prevent water ingress. The outer core shall be a sunlight and abrasion resistant black polyethylene outer jacket. Provide outdoor rated cable at all locations identified on the drawings.

2.04 CATEGORY 6A TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6A cable at frequencies up to 500MHz.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. AMP NETCONNECT; a TE Connectivity Ltd. company.
 - 2. Belden CDT Networking Division/NORDX.
 - 3. Berk-Tek Leviton; a Nexans/Leviton alliance.
 - 4. CommScope, Inc.
 - 5. General Cable; General Cable Corporation.
 - 6. Mohawk; a division of Belden Networking, Inc.
 - 7. Superior Essex Inc.
 - 8. Engineer Approved Equal
- C. General Performance Specifications: The minimum requirements for Category 6A cables shall conform to TIA/EIA 568B Commercial Building Telecommunications Cabling Standard, Horizontal Cable Section. Application standards supported should include, but not limited to:
 - 1. 10Base-T through 10GBase-T Ethernet
 - 2. Power over Ethernet (Poe & PoE+) - IEEE 802.3af/at Type 1 & 2
 - 3. 4PPoE+ - IEEE 802.3bt Type 3 and 4 draft D1.2
 - 4. 155Mb/s ATM and token ring
 - 5. HDBaseT Class A & B
 - 6. 550MHz Broadband Video
 - 7. Backwards compatible to legacy protocols and applications.
- D. General Design Specifications: Indoor horizontal cable shall be plenum, Category 6A, Unshielded Twisted Pair (UTP) composed of 23 AWG bare solid-copper conductors, insulated (FEP). The insulated conductors are twisted into pairs and sheathed with a low smoke PVC jacket. Cable shall be classified as a small diameter Category 6A cable meeting the following minimum design specifications:
 - 1. Overall Diameter: $\leq 0.265''$
 - 2. Pair Count: 4
 - 3. Conductor: Solid annealed copper 23 AWG
 - 4. Insulation CMP: FEP
 - 5. Separator: Full Cross-web
 - 6. Jacket CMP: FR, low smoke PVC, blue in color unless noted otherwise
 - 7. Impedance: $100\Omega \pm 15$
 - 8. Velocity of Propagation : CMP: 71%
 - 9. Performance Compliance: UL 444, UL 1666, NFPA 262, ANSI/TIA-568-C.2, Article 800, NEC (NFPA 70)
 - 10. NRTL Programs: UL Verified CAT 6A, UL Listed CMP-LP (0.6)
 - 11. Standard: Comply with TIA-568-C.2 for Category 6A cables.

2.05 CATEGORY 6 AND CATEGORY 6A TWISTED PAIR CABLE HARDWARE

- A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable. Category 6 and Category 6A cabling shall be terminated on a dedicated patch panel and outlet of the corresponding category class. In no case shall different Category cabling be terminated on the same patch panel.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. AMP NETCONNECT; a TE Connectivity Ltd. company.
 - 2. Belden CDT Networking Division/NORDX.
 - 3. Berk-Tek Leviton; a Nexans/Leviton alliance.
 - 4. CommScope, Inc.
 - 5. General Cable; General Cable Corporation.
 - 6. Hubbell Premise Wiring.
 - 7. Panduit.
 - 8. Engineer Approved Equal
- C. General Requirements for Twisted Pair Cable Hardware:
 - 1. Comply with the performance requirements of Category 6A.
 - 2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
 - 3. Cables shall be terminated with connecting hardware of same category or higher.
- D. Source Limitations:
 - 1. Category 6 and Category 6A cabling and connecting hardware shall be from the same manufacturer.
 - 2. Manufacturers of cabling and connecting hardware may be from different manufacturer's if the partnership of the products meets the 25 year extended warranty.
- E. Patch Panel: Blank modular patch panels housing numbered jack units with ability to accept an IDC-type keystone jack at each port location. Patch panels containing fixed, irreplaceable jacks are not acceptable.
 - 1. High density supporting 48 open modular ports
 - 2. Angled design (flat front patch panels are not acceptable).
 - 3. 2U mounting height
 - 4. Labeling areas adjacent to ports.
 - 5. Construction: 16-gauge steel and mountable on 19-inch (483 mm) equipment racks.
 - 6. Number of Jacks per Field: One for each four-pair cable indicated.
- F. Plugs and Plug Assemblies:
 - 1. Male; eight position (8P8C); color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, Category 6 or Category 6A unshielded twisted pair cable. Terminate all four cable pairs per jack unless noted otherwise on drawings.
 - 2. Standard: Comply with TIA-568-C.2.
 - 3. Marked to indicate transmission performance.
- G. Jacks and Jack Assemblies

1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, Category 6 or Category 6A unshielded twisted pair cable.
 2. Designed to snap-in to a patch panel or faceplate.
 3. Standard: Comply with TIA-568-C.2.
 4. Marked to indicate transmission performance.
 5. Coordinate color types with Owner prior to ordering.
- H. Punchdown Blocks: Termination blocks for cross-connecting horizontal cabling.
1. Application: Rated for specific Category rating required for application
 2. Termination: IDC-style capable of terminating 23 AWG solid conductors.
 3. Mounting: Wall or backplane
 4. Labeling: Designation strips or labels for labeling each circuit.
 5. Pair Count: See drawings for pair count requirements
- I. Faceplate
1. Two to Six port, vertical single gang faceplates designed to mount to single gang wall boxes or adapter.
 2. Plastic Faceplate: High-impact plastic. Coordinate color with Engineer prior to ordering.
 3. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.
 4. Flush mounting jacks, positioning the cord at a 45-degree angle.
 5. Integral, reusable clear plastic label field above and below ports.
- J. Surface Mount (Biscuit) Outlets
1. Surface mount outlets shall accept connector modules and shall be used to support data applications in open office, retrofit, and other surface-mount environments.
 2. Surface mount outlets shall be compatible with the Category 6 or 6A connector module specified in this document.
 3. Surface mount outlets shall be mounted with a screw. The use of adhesive tape is not allowed.
 4. Surface mount outlet shall be UL listed and shall be constructed of fire-retardant ABS plastic rated UL 1863 and UL 2043.
 5. Connector modules for use in surface mount outlets shall follow the same color schemes for work area outlets.
 6. Provide plenum rated surface mount outlets where noted on drawings.
- K. Patch Cords: Factory-made, four-pair cables; terminated with an eight-position modular plug at each end. Contractor shall confirm required lengths prior to placing order.
1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.
 2. Patch cords shall be manufactured and certified by the same manufacturer of the permanent link cabling.
 3. Quantity:
 - a. Provide one (1) patch cord for each terminated port inside the telecommunication rooms.
 - b. Provide one (1) patch cord for each terminated station outlet.
 - c. Contractor shall coordinate exact length of each patch cord with network system equipment provider and owner prior to ordering. Submit list of patch cords including color and length for each telecommunication room for approval by Engineer prior to ordering.

L. SURGE PROTECTORS

1. Provide surge protection devices for specific equipment as shown on drawings.
2. Point of Use Surge Protector
 - a. Shall protect circuits that use Power over Ethernet connections.
 - b. The point of use surge protector is compatible with CAT5e, CAT6 and CAT6A cabling infrastructure, and can be installed either at the equipment end, or ahead of injectors or midspan devices.
 - c. PoE Plus, HiPoE ready for high-wattage applications
 - d. RJ45 connections with external grounding screw
 - e. Complies with IEEE Std. 802.3af and 802.3at for PoE
 - f. Technical Specifications:
 - 1) Service Voltage: <60V
 - 2) Protection Modes: L-G (All), L-L (All)
 - 3) Clamping Voltage Common Mode (L-G): 75V
 - 4) Clamping Voltage Differential Mode (L-L): 72V
 - 5) Surge Current Rating: 20kA/Pair
 - 6) Max. Continuous Current: 1.5 Amps
 - 7) Power Handling: 144 Watts
 - 8) Data Rate: Up To 10GbE
 - 9) Environmental: -40F – 158F (-40C – 70C), 95% non-condensing
 - g. UL Listed UL 497B
 - h. Warranty: 10 Years
3. Rack Mounted Surge Protector
 - a. Shall protect circuits that use Power over Ethernet connections.
 - b. The rack mount surge protector is compatible with CAT5e, CAT6 and CAT6A cabling infrastructure.
 - c. PoE Plus, HiPoE ready for high-wattage applications
 - d. Individual field-replaceable modules, RJ45 connections
 - e. Complies with IEEE Std. 802.3af and 802.3at for PoE
 - f. Technical Specifications
 - 1) Service Voltage: <60V
 - 2) Protection Modes: L-G (All), L-L (All)
 - 3) Clamping Voltage Common Mode (L-G): 75V
 - 4) Clamping Voltage Differential Mode (L-L): 7.22V
 - 5) Surge Current Rating: 20kA/Pair
 - 6) Max. Continuous Current: 1.5 Amps
 - 7) Power Handling: 144 Watts
 - 8) Data Rate: Up To 10GbE
 - 9) Environmental: -40F – 158F (-40C – 70C), 95% non-condensing
 - 10) Rack mountable in standard 19" frame.
 - g. UL Listed UL 497B
 - h. Warranty: 10 Years

M. Legend:

1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

2.06 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.07 GROUNDING

- A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
- B. Comply with TIA-607-B.

2.08 SOURCE QUALITY CONTROL

- A. Factory test cables on reels according to TIA-568-C.1.
- B. Factory test twisted pair cables according to TIA-568-C.2.
- C. Cable will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3: EXECUTION

3.01 WIRING METHODS

- A. Wiring Method: Install cables in raceways except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, where cable trays and J-Hooks may be used. Conceal raceway and cables, except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for raceways and boxes specified in Section 270528 "Pathways for Communications Systems."
- B. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to termination points without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.02 INSTALLATION OF PATHWAYS

- A. Comply with requirements for demarcation point, cabinets, and racks specified in Section 271100 "Communications Equipment Room Fittings."
- B. Comply with Section 270528 "Pathways for Communications Systems."
- C. Comply with Section 270529 "Hangers and Supports for Communications Systems."
- D. Comply with Section 270536 "Cable Trays for Communications Systems."
- E. Drawings indicate general arrangement of pathways.

3.03 INSTALLATION OF TWISTED-PAIR HORIZONTAL CABLES

- A. Comply with NECA 1 and NECA/BICSI 568.
- B. General Requirements for Cabling:
 - 1. Comply with TIA-568-C.0, TIA-568-C.1, and TIA-568-C.2.
 - 2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
 - 3. Do not untwist twisted pair cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
 - 4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 5. Cables may not be spliced. Secure and support cables at intervals not exceeding 36 inches not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 6. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
 - 7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.
 - 8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation, and replace it with new cable.
 - 9. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.
 - 10. In the communications equipment room, install a 10-foot (3-m) long service loop on each end of cable.
 - 11. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. Monitor cable pull tensions.
 - 12. Cable shall be terminated on connecting hardware that is rack or cabinet mounted.
- C. Cable Installation:
 - 1. Comply with TIA-568-C.0 and TIA-568-C.2.
 - 2. Install cabling with horizontal and vertical cable guides in communications equipment rooms with terminating hardware and interconnection equipment.
 - 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- D. Group connecting hardware for cables into separate logical fields.
- E. Separation from EMI Sources:
 - 1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.
 - 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

- a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).
- 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
- 4. Separation between communications cables in grounded metallic raceways, power lines, and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
- 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
- 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.04 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with "Firestopping Systems" Article in BICSI's "Telecommunications Distribution Methods Manual."

3.05 GROUNDING

- A. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."
- B. Comply with TIA-607-B and NECA/BICSI-607.

3.06 IDENTIFICATION

- A. Cable Management Software: This contractor shall be responsible for updating the existing airport cable management software program with all communications copper horizontal cables installed as part of this project.
- B. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- C. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 2 level of administration.
- D. Cable Schedule: Install in a prominent location in each communication equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- E. Cable and Wire Identification:
 - 1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Identification within patch panels in communication equipment rooms: Label each connector and each discrete unit of cable terminating and connecting hardware.
- F. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:
 - 1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.07 FIELD QUALITY CONTROL AND TESTING

- A. General:
 - 1. This Section includes the minimum requirements for the test certification, identification and administration of horizontal balanced twisted pair cabling.
 - 2. This Section includes minimum requirements for:
 - a. Copper cabling test instruments
 - b. Copper cabling testing
 - c. Administration
 - d. Test results documentation
 - 3. Testing shall be carried out in accordance with this document.
 - 4. Testing shall be performed on each cabling link. (100% testing)
 - 5. All tests shall be documented.
- B. Requirements
 - 1. All testing procedures and field-test instruments shall comply with the latest version and applicable requirements of ANSI/TIA/EIA standards addressing the testing and administration of Category 6A copper horizontal cabling.

2. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests.
 3. The Owner or the Owner's representative shall be invited to witness field-testing.
 - a. The Owner or the Owner's representative shall be notified of the start date of the testing phase five (5) business days before testing commences.
 4. Manufacturers catalog sheets and specifications for the test equipment.
 5. A schedule (list) of all balanced twisted-pair copper links to be tested.
 6. Sample test reports.
- C. Test Limits and Parameters
1. Unless otherwise specified by the Owner or the Owners representative, each cabling link shall be tested for:
 - a. Wire Map
 - b. Length
 - c. Propagation Delay
 - d. Delay Skew
 - e. DC Loop Resistance
 - f. DC Resistance Unbalance within a pair
 - g. DC Resistance Unbalance between pairs
 - h. Insertion Loss
 - i. NEXT (Near-End Crosstalk)
 - j. PS NEXT (Power Sum Near-End Crosstalk)
 - k. ACR-N (Attenuation to Crosstalk Ratio Near-End)
 - l. PS ACR-N (Power Sum Attenuation to Crosstalk Ratio Near-End)
 - m. ACR-F (Attenuation to Crosstalk Ratio Far-End)
 - n. PS ACR-F (Power Sum Attenuation to Crosstalk Ratio Far-End)
 - o. Return Loss
 - p. TCL (Transverse Conversion Loss)
 - q. ELTCTL (Equal Level Transverse Conversion Transfer Loss)
 - r. PS ANEXT (Power Sum Alien Near-End Crosstalk)
 - s. Average PS ANEXT (Average Power Sum Alien Near-End Crosstalk)
 - t. PS AACR-F (Power Sum Alien Attenuation to Crosstalk Ratio Far-End)
 - u. Average PS AACR-F (Average Power Sum Alien Attenuation to Crosstalk Ratio Far-End)
 2. All installed cabling Permanent Links shall be field-tested and pass the test requirements and analysis as described in the Copper Horizontal Cable Testing section. Any Permanent Link that fails these requirements shall be diagnosed and corrected. Any corrective action that must take place shall be documented and followed with a new test to prove that the corrected Permanent Link meets performance requirements. The final and passing result of the tests for all Permanent Links shall be provided in the test results documentation in accordance with the Copper Horizontal Cable Testing section of this specification.

3. Acceptance of the test results shall be given in writing after the project is fully completed and tested in accordance with Contract Documents and to the satisfaction of the Owner.

D. Testing Equipment

1. The field-test instrument shall be within the calibration period recommended by the manufacturer and a copy of the calibration certificate made available.
2. Acceptable manufacturers
 - a. Fluke Networks
 - b. Tektronix
 - c. Engineer Approved Equal

E. Administration

1. Administration of the documentation shall include test results of each Permanent Link.
2. The test result information for each link shall be recorded in the memory of the field-test instrument upon completion of the test.
3. The test result records saved within the field-test instrument shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of these test records.

F. Copper Horizontal Cable Testing

1. All outlets, cables, patch panels and associated components shall be fully assembled and labeled prior to field-testing. Any testing performed on incomplete systems shall be redone on completion of the work.
2. Field-test instruments shall have the latest firmware installed.
3. Permanent Link test results, including the individual frequency measurements from the tester, shall be recorded in the test instrument upon completion of each test for subsequent uploading to a Windows™-based database utility in which the administrative documentation (reports) may be generated.
4. Permanent Link testing shall be performed on each cabling segment (connector to connector). Sampling is not acceptable.
5. Alien Crosstalk testing shall be performed using a sampling plan. An acceptance quality level (AQL) of 0,4 %, normal inspection, general inspection level I as defined in ISO 2859-1 for populations of up to 500,000 links shall be used. The following table represents this sampling level.

Total number of links (N)	Sample size (No. of links to test)
3 – 33	3 or 0.1 x N (whichever is greatest)
34 – 3,200	33
3,201 – 35,000	126
35,001 – 150,000	201
150,001 – 500,000	315

6. Disturbed (Victim) links chosen for Alien Crosstalk testing shall be an equal combination of short, medium and long links.
7. Provide test results for each parameter listed under paragraph 3.07-C.1, this section. All tests shall meet or exceed the limits found in ANSI/EIA-568-C.2, 6.3.

G. Administration:

1. Test Results Documentation

- a. The test results documentation shall be available for inspection by the Owner or the Owner's representative during the installation period and shall be passed to the Owner's representative within 5 working days of completion of tests.
- b. The database for the complete project shall be stored and delivered on CD/DVD prior to Owner acceptance of the building in the original format used by the cabling vendors' software.
- c. Circuit IDs reported by the test instrument should match the cable label ID.
- d. The detailed test results documentation data is to be provided in an electronic database for each tested optical fiber and shall contain the following information:
 - 1) The overall Pass/Fail evaluation of the link-under-test
 - 2) The date and time the test results were saved in the memory of the tester
 - 3) The identification of the customer site as specified by the end-user
 - 4) The name of the test limit selected to execute the stored test results
 - 5) The name of the personnel performing the test
 - 6) The version of the test firmware and the version of the test limit database held within the test instrument
 - 7) The manufacturer, model and serial number of the field-test instrument
 - 8) The adapters used
 - 9) The factory calibration date
 - 10) Provide test results for each parameter listed under paragraph 3.07-C.1, this section.
- e. For Alien Crosstalk testing, the detailed test results documentation data is to be provided for each tested balance twisted-pair and shall contain the following information:
 - 1) The overall Pass/Fail evaluation of the link-under-test
 - 2) The date and time the measurements were made
 - 3) The identification of the customer site as specified by the end-user
 - 4) The name of the test limit selected to execute the stored test results
 - 5) The name of the personnel performing the test
 - 6) The version of the test software
 - 7) PS ANEXT, worst case margin for all four pairs
 - 8) Average PS ANEXT, worst case margin
 - 9) PS AACR-F, worst case margin for all four pairs
 - 10) Average PS AACR-F, worst case margin

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SECTION 27 15 23 - COMMUNICATIONS OPTICAL FIBER HORIZONTAL CABLING

PART 1: GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Provide work specified but not shown on Drawings, and work shown on Drawings but not specified, as though expressly required by both.

1.02 SUMMARY

- A. Section Includes:
 - 1. 9/125 micrometer, single mode, indoor-outdoor, optical fiber cable (OS2).
 - 2. Optical fiber cable connecting hardware, patch panels, and patch cords.
 - 3. Grounding.
 - 4. Cabling identification products.

1.03 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. RCDD: Registered Communications Distribution Designer.

1.04 OPTICAL FIBER HORIZONTAL CABLING DESCRIPTION

- A. Optical fiber horizontal cabling system shall provide interconnections between communications equipment rooms and the equipment outlet. Cabling system consists of horizontal cables, patch panels, connectors, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.
 - 1. Splices and consolidation/transition points shall not be installed in the optical fiber horizontal cabling.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Reviewed and stamped by RCDD.
 - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 - 2. Floor Plans: that identify device locations, cable routes and quantities, cable types, riser locations, and references to installation details and diagrams.

- 3. Diagrams/Elevations: showing room layouts, rack layouts (including elevations), riser layouts, etc.
- C. Fiber optic cable testing plan.
- 1.06 INFORMATIONAL SUBMITTALS
 - A. Qualification Data: For RCDD.
 - B. Source quality-control reports.
 - C. Field quality-control reports.
- 1.07 CLOSEOUT SUBMITTALS
 - A. Maintenance Data: For optical fiber cable, splices, and connectors to include in maintenance manuals.
- 1.08 WARRANTY
 - A. Period: The Contractor shall warranty all labor, workmanship, and materials for a period of one (1) year from the date of final Owner acceptance. Should a failure occur within this warranty period, the Contractor shall provide all labor and materials necessary to restore the system to the condition required for the final test and acceptance for this contract, at no cost to the Owner.
 - B. Extended Warranty: The manufacturer shall guarantee in writing that the optical fiber horizontal cable channels as installed by this contract are free from defects in materials and workmanship and will meet the applicable ANSI/TIA/EIA and ISO/IEC channel transmission requirements in effect at the time of installation and will support any current or future application ratified by IEEE, ANSI, or ISO designed to operate over the applicable ANSI/TIA/EIA-568-B and ISO/IEC 11801 standards in effect at the time of installation. The duration of this warranty shall be for a period of 25 years from date of final Owner acceptance. Defective products shall be repaired or replaced by the manufacturer, at no cost to the Owner.
- 1.09 QUALITY ASSURANCE
 - A. Installer Qualifications: Cabling installer must be a certified installer meeting all requirements for the cable manufacturer's 25 year warranty program and must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings by an RCDD.
 - 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
- 1.10 DELIVERY, STORAGE, AND HANDLING
 - A. Test cables upon receipt at Project site.

1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.

1.11 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.12 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with all other trades and service providers, if applicable.

PART 2: PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.
- B. Surface-Burning Characteristics: Flame spread shall not exceed 5 ft (1.5 m) when tested in accordance with NFPA 262.
- C. Telecommunications Pathways and Spaces: Comply with TIA-569-D.
- D. Grounding: Comply with TIA-607-B.

2.02 9/125 MICROMETER SINGLE-MODE, ARMORED, INDOOR-OUTDOOR OPTICAL FIBER CABLE (OS2)

- A. Description: Single mode, 9/125-micrometer, tight-buffered, armored optical fiber cable. Refer to drawings for strand count.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. Belden CDT Networking Division/NORDX.
 2. Corning Cable Systems.
 3. General Cable; General Cable Corporation.
 4. Mohawk; a division of Belden Networking, Inc.
 5. Superior Essex Inc.
 6. Engineer Approved Equal
- C. General: Fiber optic cable construction shall consist of 8.3 μ m single mode optical fibers typically formed in groups of six (6) or twelve (12) fibers each. Size, strand count and routing of fiber optic cables shall be as indicated on the drawings. These groups and individual fibers shall exceed all requirements for ANSI/TIA/EIA-568-B.3 and support high speed communication network

applications. These groups assembled to form a single compact core, which is covered by a protective sheath.

D. Optical Fiber Requirements and Performance:

1. Core Diameter: 8.3μm
2. Cladding Diameter: 125μm ± 1μm
3. Cladding Non-Circularity: ≤ 1%
4. Core/Cladding Concentricity Error: 0.5μm
5. Colored Fiber Diameter: 254μm ± 7μm
6. Minimum Bandwidth: 20GHz
7. Maximum Attenuation:
 - a. 1310nm ≤ 0.65 dB/km
 - b. 1550nm ≤ 0.50 dB/km

E. Design Specifications: Provide cable suitable for installation in both indoor (plenum) and outdoor environments with tight-buffered cable. Cable jacket shall meet the following specification:

1. Jacket Color: Black.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).
4. Plenum Applications: Cables shall be UL 910 listed OFNP.
5. Armor Material: The armor material shall be constructed of aluminum interlocking armor. The armor of each optical cable shall be bonded to the ground busbar located in the rack. An additional outer jacket shall be placed over the armor. The color of the armor jacket shall match the jacket color of the optical fiber cable located inside of the armor.

F. Single-mode (Dispersion Un-shifted): All single-mode fiber shall support 10 Gigabit Ethernet (10 Gbps) to distances of up to 10,000 meters @ 1310 nm and 40,000 meters @ 1550 nm per IEEE 802.3 performance. The single-mode fiber utilized in the optical fiber cable shall meet TIA-492CAAB, "Detail Specification for Class Iva Dispersion-Unshifted Single-Mode Optical Fibers with Low Water Peak," and ITU recommendation G.652 "Characteristics of a single-mode optical fiber cable."

G. Identification: The individual fibers shall be color coded for identification. The optical fiber color coding shall be in accordance with EIA/TIA-598, "Optical Fiber Cable Color Coding." When buffered fibers are grouped into individual subunits, each subunit jacket shall be numbered for identification, with the exception of filler subunits where used. The outer jacket shall be marked with the manufacturer's name or ETL file number, date of manufacture, fiber count, fiber type, flame rating, listing symbol, and sequential length markings every two feet.

2.03 OPTICAL FIBER CABLE HARDWARE AND PATCH CORDS

- A. Comply with requirements in Section 271323 Communications Optical Backbone Cabling” for optical fiber cable hardware and patch cords.

2.04 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.05 GROUNDING

- A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
- B. Comply with TIA-607-B.

2.06 SOURCE QUALITY CONTROL

- A. Factory test optical fiber cables according to TIA-526-14-B and TIA-568-C.3.
- B. Cable will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

PART 3: EXECUTION

3.01 WIRING METHODS

- A. Wiring Method: Install cables in raceways except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, where cable trays and J-Hooks may be used. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for pathways specified in Section 270528 "Pathways for Communications Systems."
- B. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to termination points without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.02 INSTALLATION OF OPTICAL FIBER HORIZONTAL CABLES

- A. Comply with NECA 301.
- B. General Requirements for Optical Fiber Cabling Installation:
 - 1. Comply with TIA-568-C.1 and TIA-568-C.3.
 - 2. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."
 - 3. Terminate and test all cables; no cable shall contain unterminated elements. Make terminations only at indicated outlets and patch panels.
 - 4. Cables may not be spliced. Secure and support cables at intervals not exceeding 36 inches and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 - 6. Bundle, lace, and train cable to termination points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.

7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination points. Remove and discard cable if damaged during installation and replace it with new cable.
 8. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.
 9. In the communications equipment room, provide a 10-foot (3-m) long service loop on each end of cable.
 10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
 11. Cable shall be terminated on connecting hardware that is rack or cabinet mounted.
- C. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in communications equipment rooms with terminating hardware and interconnection equipment.
 2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- D. Group connecting hardware for cables into separate logical fields.

3.03 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-C, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.04 GROUNDING

- A. Shields/armors shall be grounded according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with TIA-607-B and NECA/BICSI-607.
- C. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.05 IDENTIFICATION

- A. Cable Management Software: This contractor shall be responsible for updating the existing airport cable management software program with all communications optical fiber horizontal cables installed as part of this project.
- B. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- C. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 2 level of administration.
- D. Cable Schedule: Install in a prominent location in each communication equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect

with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

E. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Identification within patch panels in communications equipment rooms: Label each connector and each discrete unit of cable-terminating and connecting hardware.

F. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606-B, for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.06 FIELD QUALITY CONTROL AND TESTING

A. General:

1. This Section includes the minimum requirements for the test certification, identification and administration of backbone and horizontal optical fiber cabling.
2. This Section includes minimum requirements for:
 - a. Fiber optic test instruments
 - b. Fiber optic testing
 - c. Administration
 - d. Test results documentation
3. Testing shall be carried out in accordance with this document. This includes testing the attenuation and polarity of the installed cable plant with an optical loss test set (OLTS). In addition to OLTS testing the optical fiber cabling may require testing with an optical time domain reflectometer (OTDR), this is defined elsewhere in this section.
4. All tests shall be documented including OLTS dual wavelength attenuation measurements and OTDR traces with event tables as well as OTDR maps where OTDR testing is required.

B. Requirements:

1. All testing procedures and field-test instruments shall comply with the latest version and applicable requirements of ANSI/TIA/EIA standards addressing the testing and administration of optical fiber cabling.
2. Trained technicians who have successfully attended an appropriate training program, which includes testing with an OLTS and an OTDR and have obtained a certificate as proof thereof shall execute the tests.
3. The Owner or the Owner's representative shall be invited to witness field-testing.
 - a. The Owner or the Owner's representative shall be notified of the start date of the testing phase five (5) business days before testing commences.
4. Manufacturers catalog sheets and specifications for fiber optic field-test instruments including optical loss test sets (OLTS; power meter and source) and optical time domain reflectometer (OTDR), if required.
5. A schedule (list) of all optical fibers to be tested.
6. Sample test reports.

C. Test Limits and Parameters

1. Unless otherwise specified by the Owner or the Owners representative, each cabling link shall be in compliance with the following test limits:

a. Optical Loss Testing

- 1) Multimode and Singlemode links: The link attenuation shall be calculated by the following formulas as specified in ANSI/TIA-568-C.0.
- a) $\text{Link\_Attenuation (dB)} = \text{Cable\_Attn (dB)} + \text{Connector\_Attn (dB)} + \text{Splice\_Attn (dB)}$
 - b) $\text{Cable\_Attn (dB)} = \text{Attenuation\_Coefficient (dB/km)} * \text{Length (Km)}$
 - c) $\text{Connector\_Attn (dB)} = \text{number\_of\_connector\_pairs} * \text{connector\_loss (dB)}$
 - d) Maximum allowable connector_loss = 0.75 dB
 - e) $\text{Splice\_Attn (dB)} = \text{number\_of\_splices} * \text{splice\_loss (dB)}$
 - f) Maximum allowable splice_loss = 0.3 dB
 - g) The values for the Attenuation_Coefficient (dB/km) are listed in the table below:

Type of Optical Fiber	Wavelength (nm)	Attenuation coefficient (dB/km)	Wavelength (nm)	Attenuation coefficient (dB/km)
Multimode 62.5/125 μm	850	3.5	1300	1.5
Multimode 50/125 μm	850	3.5	1300	1.5
Single-mode (Inside plant)	1310	1.0	1550	1.0
Single-mode (Outside plant)	1310	0.5	1550	0.5

2. OTDR Testing

- a. In addition to OLTS testing, OTDR testing shall be required for optical fiber cabling containing a splice within the link length of the cable run. Splices made to connect break-out kits and pig tails are not required to be tested by an OTDR.
- b. Reflective events (connections) shall not exceed:
- 1) 0.75 dB in optical loss when bi-directionally averaged
 - 2) -35 dB Reflectance for multimode connections
 - 3) -40 dB reflectance for UPC singlemode connections
 - 4) -55 dB reflectance for APC singlemode connections
- c. Non-reflective events (splices) shall not exceed 0.3 dB.

3. All installed cabling links and channels shall be field-tested and pass the test requirements and analysis as described under Optical Fiber Cable Testing section of this specification. Any link or channel that fails these requirements shall be diagnosed and corrected. Any corrective action that must take place shall be documented and followed with a new test to prove that the corrected link or channel meets performance requirements. The final and passing result of the tests for all links and channels shall be provided in the test results

documentation in accordance with the Optical Fiber Cable Testing section of this specification.

4. Acceptance of the test results shall be given in writing after the project is fully completed and tested in accordance with Contract Documents and to the satisfaction of the Owner.

D. Testing Equipment:

1. The field-test instrument shall be within the calibration period recommended by the manufacturer and a copy of the calibration certificate made available.
2. Acceptable manufacturers
 - a. Fluke Networks
 - b. Tektronix
 - c. Engineer Approved Equal

E. Test Records:

1. Administration of the documentation shall include test results of each fiber link and channel.
2. The test result information for each link shall be recorded in the memory of the field-test instrument upon completion of the test.
3. The test result records saved within the field-test instrument shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of these test records.

F. Optical Fiber Testing

1. Field-test instruments shall have the latest software and firmware installed.
2. Testing shall be performed on each cabling link (connector to connector).
3. Testing shall be performed on each cabling channel (equipment to equipment) as identified in the contract documents.
 - a. Testing shall not include any active devices or passive devices within the link or channel other than cable, connectors, and splices, i.e. link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.
4. Testing of the cabling shall be performed using high-quality test reference cords of the same core size as the cabling under test, terminated with reference grade connectors. Reference grade connectors are defined as having a loss not exceeding 0.1 dB for multimode and 0.2 dB for singlemode.
5. OLTS Testing
 - a. Horizontal/Backbone link
 - 1) Multimode links shall be tested in one direction at 850 nm and 1300 nm in accordance with ANSI/TIA-526-14-B, one-cord reference method, with an Encircled Flux compliant launch.
 - 2) Singlemode backbone links shall be tested in one direction at 1310 nm and 1550 nm in accordance with ANSI/TIA/EIA-526-7, Method A.1 (One-cord reference method).
 - 3) Link attenuation does not include any active devices or passive devices other than cable, connectors, and splices, i.e. link attenuation does not

include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.

6. OTDR Testing

- a. Fiber links shall be tested at these wavelengths for anomalies and to ensure uniformity of cable attenuation, connector insertion loss and reflectance.
 - 1) Multimode: 850 nm and 1300 nm.
 - 2) Singlemode: 1310 nm and 1550 nm.
- b. Each fiber link and channel shall be tested in both directions.
 - 1) The launch and tail fibers shall remain in place for the measurement in the opposite direction – failing to do so will result in an increase in measurement uncertainty.
 - 2) The use of a loop back fiber at the far end with a tail fiber at the near end on the adjacent fiber is permitted for bi-directional testing, so long as the OTDR is able to split the trace automatically into two traces for the two fibers under test.
- c. A launch cable shall be installed between the OTDR and the first link connection.
- d. A tail cable shall be installed after the last link connection.

7. Length Measurement

- a. The optical length of each fiber shall be recorded using an OLTS or OTDR.

8. Polarity Testing

- a. Paired duplex fibers in multi-fiber cables shall be tested to verify polarity in accordance with Clause E.5.3 of ANSI/TIA 568 C.0. The polarity of the paired duplex fibers shall be verified using an OLTS.

G. Administration

1. Test results documentation

- a. The test results documentation shall be available for inspection by the Owner or the Owner's representative during the installation period and shall be passed to the Owner's representative within 5 working days of completion of tests.
- b. The database for the complete project shall be stored and delivered on CD/DVD prior to Owner acceptance of the building in the original format used by the cabling vendors' software.
- c. Circuit IDs reported by the test instrument should match the cable label ID.
- d. The detailed test results documentation data is to be provided in an electronic database for each tested optical fiber and shall contain the following information:
 - 1) The identification of the customer site as specified by the end-user.
 - 2) The name of the test limit selected to execute the stored test results.
 - 3) The name of the personnel performing the test.
 - 4) The date and time the test results were saved in the memory of the tester.
 - 5) The manufacturer, model and serial number of the field-test instrument.
 - 6) The version of the test software and the version of the test limit database held within the test instrument.
 - 7) The fiber identification number.

- 8) The length for each optical fiber.
- 9) The index of refraction used for length calculation when using length capable OLTS.
- 10) The backscatter coefficient of the fiber under test when using an OTDR.
- 11) Test results to include OLTS attenuation link and channel measurements at the appropriate wavelength(s) and the margin (difference between the measured attenuation and the test limit value).
- 12) Test results to include OTDR link and channel traces, event tables at the appropriate wavelength(s) and a map of the link tested.
- 13) The length for each optical fiber as calculated by the OTDR.
- 14) The overall Pass/Fail evaluation of the link-under-test for OLTS and OTDR measurements.

END OF SECTION 27 15 23

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SECTION 27 21 00 LOCAL AREA NETWORK

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.
- B. Provide work specified but not shown on Drawings, and work shown on Drawings but not specified, as though expressly required by both.
- C. All sections of Division 27 and 28 of these specifications also apply to this section.

1.2 SCOPE

- A. The scope of work for this project includes all materials, equipment, hardware, software, licensing, and labor to expand the existing PGD network with new access layer switches to support new end devices such as IP POE cameras, wireless access points, PC's and VOIP telephones. SFP modules shall be provided for both the new access switch and the core switch located in the airport Admin Building to support the backbone connection. The Contractor shall configure the networking equipment and make new access ports ready for use in the existing airport network. The Contractor shall provide all products required to ensure a fully operative system and provide proper installation of all equipment.
- B. Coordinate with airport IT department for configuration details.
- C. The equipment in this specification shall be installed in a new, or expanded, telecommunications room at PGD.

1.3 DEFINITIONS

- A. LAN: Local Area Network
- B. Owner/Airport: Mid America International Airport (PGD)
- C. AAA – Authentication, Authorization, and Accounting
- D. ACL – Access Control List
- E. ANSI – American National Standards Institute
- F. BICSI – Building Industry Consulting Service International
- G. BUY AMERICA – Buy America Act of 1933 with respect to FAA ADO Governance
- H. CASN – Converged Airport Security Network
- I. DHCP – Dynamic Host Configuration Protocol
- J. DiffServ – Differentiated Services

- K. DNS – Domain Name Service
- L. DoS – Denial of Service
- M. EIA – Electronic Industries Alliance
- N. Gbps – Gigabits per second
- O. IEC – International Electrotechnical Commission
- P. IEEE – Institute of Electrical and Electronics Engineers
- Q. IGMP – Internet Group Management Protocol
- R. IP – Internet Protocol
- S. IPv6 – Internet Protocol version 6
- T. ISO – International Organization for Standardization
- U. LLDP – Link Layer Discovery Protocol
- V. MAC – Media Access Control
- W. Mb/s / Mbps – Megabits per second
- X. ms – Milliseconds
- Y. NECA – National Electrical Contractors Association
- Z. NFPA – National Fire Protection Association
- AA. NIST – National Institute of Standards and Technology
- BB. NMS – Network Monitoring Software
- CC. PIM-SM – Protocol Independent Multicast – Sparse Mode
- DD. PoE – Power over Ethernet
- EE. RADIUS – Remote Authentication Dial-In User Service
- FF. SSHv2 – Secure Shell version 2
- GG. SSI/Sensitive Security Information: Information that, if publicly released, would be detrimental to transportation security, as defined by Federal Regulation 49 C.F.R. Part 1520
- HH. TIA – Telecommunications Industry Association
- II. TR – Telecommunication Room
- JJ. UL – Underwriters Laboratories
- KK. VLAN – Virtual Local Area Network

LL. VPN: Virtual Private Network

1.4 SUBMITTALS

A. Product Data shall include the following:

1. Product Data: Provide manufacturer's specification sheets for each component. Provide electrical power consumption rating and heat generation for each power-consuming device, and a summary of the entire system quoted. The summary should include an inventory of all active LAN components and all spare parts required for procurement as identified in sections 2 (PRODUCTS) and 3 (EXECUTION) of this document respectively.

1.5 WARRANTY

- A. Provide a one (1) year manufacturer-based warranty on all equipment and as new under this contract. If, within one (1) year after the date of Final Acceptance of the Project or by the terms of any applicable special warranty provided by the manufacturer, any of the Project or equipment is found to be defective or not in accordance with the Contract Documents, the Contractor shall correct it promptly including all parts and labor after receipt of notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such defective conditions. The Owner will give such notice promptly after discovery of the condition. Such notice shall be provided by Owner representatives, to be identified either verbally or in writing.
- B. During the Warranty period, the Contractor shall, upon receipt of a request for service from the Owner, deploy service personnel to the Owner's premises and complete corrective action within twenty-four (24) hours of arriving on site. Coordination with the Mid America International Airport IT Department is required.
- C. Repair or replacement service during the warranty period shall be performed in accordance with the following schedule:
1. Seven (7) days, twenty-four (24) hour, three (3) hour on-site response time shall apply for major system failure. A major system failure is defined as a failure that causes multiple portions of a system to be unable to perform the task for which it was intended or creates a potential for an immediate security breach.
 2. Next business day response time shall apply for minor component and device failures.
- D. The Owner shall be the sole authority to define a failure as a major or minor system failure.
- E. If the Contractor is unable to restore system operation during the warranty period within twenty-four (24) hours of a reported failure, the Owner reserves the right to require the Contractor to provide on-site manufacturer's service technicians at no additional cost.
- F. Immediately following the completion of a Warranty repair or service call, the Contractor's service personnel shall submit a written report to the Owner which details the service work performed, the cause of the trouble, and any outstanding work which is required to restore complete and normal operation.
- G. The Owner reserves the right to expand or add to the environment during the warranty period using people other than the Contractor for such expansion without affecting the Contractor's responsibilities on the components originally provided by them, as long as the expansion is done by people who are authorized by the owner and are certified by the manufacturer. Coordination of work shall be done between the Punta Gorda Airport IT Department and the Contractor. All work done via both parties shall

be completed using the maximum level of auditing, change control and permission tracking as is available at the time of the change.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Network equipment installer must be a certified professional (CCNP) meeting all requirements for the equipment manufacturer's reseller and warranty programs. Proof of such certifications must be provided with bid response.
- B. Contractor must provide documentation as part of their bid response to indicate that they have a minimum of two (2) project experience within the last five (5) years in Commercial Airports in the USA.
- C. The Contractor providing the LAN equipment shall assign a project manager that directly reports to the Installation Contractor to support the specific coordination requirements associated with the installation of the LAN equipment.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Network switches and related equipment must be tested by the Contractor upon receipt at Project site.
 - 1. Verify that equipment received from the manufacturer is not Dead on Arrival (DoA) and parts match what was ordered.
 - 2. PGD Representatives must be afforded the option to witness successful testing prior to system acceptance.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install switches and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.9 COORDINATION

- A. The installation of the new network equipment must be done in a coordinated manner to avoid System outages on either the existing or new system. System-wide outages will only be allowed during non-operational hours of Midnight and 4:00AM local time. Outage of an individual portal associated with the terminal must be coordinated with the Owner to avoid disruption of airline and TSA activities. The Contractor must schedule any required outages with the Owner or their designated representative a minimum of three (3) days in advance to allow for alternative arrangements to be made if necessary. Major system outages lasting several hours are required to be approved by the Owner and scheduled a week in advance. Each scheduled outage must include an estimate of the approximate down time for the system and a written plan for providing mitigation in the event the outage extends beyond the estimated service interruption. If the scheduled activity cannot be performed at the scheduled time due to Irregular Operations (IROPS) the contractor must have an alternate work activity planned to avoid lack of progress.

PART 2 - PRODUCTS

2.1 GENERAL DESCRIPTION

- A. The Contractor shall provide all equipment, materials, labor, and design and coordination services necessary to complete or perfect all parts of the Local Area Network Equipment, and to ensure that they follow requirements stated or reasonably inferred by this Specification. Wherever herein the term “provide” or “provided” is used it shall be defined as procure and install as required for a fully functional and correctly operational system. All equipment under this Section shall be provided, maintained, and operated during the construction and implementation period and shall be tested and commissioned by the Contractor.
- B. The Contractor shall perform all required coordination with the PGD Representative and stakeholders to finalize all configuration, functional, operational, and performance requirements of the network design.
- C. Approved Manufacturers
 - 1. Network Equipment
 - a. Cisco (All Switches)
 - b. PGD Approved Equal
- D. The network will consist of:
 - 1. All new access layer switches will provide a minimum of two (2) active-active and load sharing / non-blocking 10 Gbps connections back to the MDF via existing SMF. One connection will terminate into the first core switch, and the second will terminate into the second core switch.
 - 2. The redundant links should be configured to support load-sharing via a non-blocking Layer 2 uplink technology such as Cisco Stackwise Virtual Port Channels or an equivalent technology if another switch vendor is approved.
 - 3. All new access layer switches shall be configured with appropriately sized power supplies to provide PoE+ to all 48-ports.
 - 4. Every access layer switch (including hardened / industrial models) shall leave 20% spare port capacity open per switch to provide future growth room into the converged network environment at PGD. For a typical indoor access switch, this means anytime 38 ports of a single switch are consumed, and a 39th port is required, an additional 48-port access switch must be added into the stack.
 - 5. Access layer switches must be stacked (where required) for both data and power by using the stacking cable assembly recommended by the manufacturer for the specific model of switch installed. The stacking cable assembly must provide the highest data throughput rate possible for that model of switch and must be of a distance greater than or equal to what is acceptable to PGD to have between switches within the same rack. Switch stacking is required anytime 38 ports of a single switch are consumed, and a 39th port is required as part of the converged network design (so as to leave 20% spare capacity open per switch member, or 10 total ports open per switch whether stacked or not).
 - 6. In cases where existing fiber infrastructure does not allow for dual uplinks to be physically provided to a new access layer switch, the switch shall still be logically configured to support the same future fiber redundancy to both MDF core switches. This will include configuration of all required VLANs to spare uplinks or Port Channel members designated for future deployment but will not include the installation of any SFPs or physical cabling infrastructure.
 - 7. Access Switches must be located in telecommunication rooms and/or enclosures, as shown in drawings.
 - 8. In the case which switch stacking is used, network uplinks must be staggered across stack members. This means if an additional uplink module is required for a different switch within the same stack that it should be supplied as part of the design to provide the intended redundancy.
 - 9. Dual switch images should be supplied to all switches.

10. Redundant power supply options must be supplied for all new switches. Power stacking is allowed via power + data stacking cable assemblies as long as PoE+ of 30W continues to be supplied to all 48-ports on every switch (whether it is stacked or not).
 11. Devices shall perform at line-rate OSI L2 and L3 - with all ports, uplinks and stack modules operating at 100% utilization
 12. All switches must be licensed with DNA Advantage licensing with a minimum subscription of 5 years.
 13. Core switches must be licensed with Cisco Smartnet Warranty Services subscription with a 24x7x4 Hours SLA for a minimum of 3 years.
 14. Access switches must be licensed with Cisco Smartnet Warranty Services subscription with a 24x7xNBD SLA for a minimum of 3 years.
- E. Authentication and access control
1. User authentication via IEEE 802.1x
 2. 802.1x – single port MAC based authentication
- F. Access Security
1. No performance degradation shall be observed when required to secure the network with one-hundred twenty (120) access control lists
 2. Support L2/L3/L4 ACLs shall be provided
 3. ACLs shall be able to be applied to port ingress
 4. 1Mb/s Ingress rate limiting shall be provided
- G. Each switch shall support IPv6
- H. Multicast Support
1. Line rate multicast forwarding with 255 multicast groups per device shall be provided
 2. Multicast Packet Latency < 10ms with 255 multicast groups, 64byte frames shall be provided
 3. Provide RFC 2362 PIM-SM
 4. Provide RFC 2236 IGMP v2
- I. Quality of Service – Installed network shall:
1. Guarantee delivery of high priority traffic regardless of congestion load
 2. Provide a minimum of eight (8) traffic queues per port
 3. Support per port rate limiting
 4. Adhere to IEEE 802.1D – 1998 (802.1p) packet priority
 5. Adhere to RFC 2474 DiffServ precedence, including 8 queues per port
 6. Adhere to RFC 2598 DiffServ Expedited Forwarding
 7. Adhere to RFC 2597 DiffServ assured forwarding
 8. Adhere to RFC 2475 DiffServ core and edge router functions
- J. Management and Operations – Installed network shall:
1. Provide secure shell (SSHv2) remote access
 2. Provide management access authentication via RADIUS
 3. Provide management access authentication via IP access control lists
 4. Adhere to IEEE 802.1ab Link Layer Discovery Protocol (LLDP)
 5. Adhere to Cisco Discovery Protocol (CDP)

2.2 GENERAL REQUIREMENTS

- A. This section includes the minimum requirements for Local Area Network Equipment.
- B. The equipment in this specification shall be installed in cabinets and racks in telecommunications rooms at PGD airport buildings as indicated on the drawings and specified herein.
- C. The scope of work for this project includes all materials, equipment, hardware, software, and labor to install and make ready for use Local Area Network equipment. It is the responsibility of the Contractor to perform the necessary coordination with the PGD Construction Manager or PGD Representative and other contractors performing work associated with this project to ensure all networking requirements are met by the installed LAN equipment.
- D. The Contractor shall be responsible for providing the following installation items as they relate to the
- E. LAN:
 - 1. Active network components (Access Layer switches and associated components)
 - 2. Providing the physical installation and configuration of all network augments as specified in Section 2.1 D.
 - 3. The coordination with the PGD Construction Manager or PGD Representative and the cabling infrastructure installation contractor to review, assess, and perform all necessary coordination with the cabling infrastructure.
 - 4. All fiber and copper patch cords between all networking devices that are described herein and are required for a complete, fully functional system. All patch cords provided by Contractor shall be in conformance with BICSI and ANSI/TIA/EIA standards and approved by the PGD Construction Manager or PGD Representative.
 - 5. The coordination of the installation of fiber patch cords with the PGD Construction Manager or PGD Representative.
 - 6. The coordination of drawings or other reference materials with the PGD Construction Manager or PGD Representative.
 - 7. The labeling of all newly installed LAN components shall be coordinated with the PGD representative and approved prior to installation.
 - 8. The coordination of electrical requirements for the LAN with the PGD Construction Manager, including specific plug configurations to support the LAN equipment.
- F. The Contractor shall verify system operability and proper installation via completion of all required test plans.

2.3 ACCESS LAYER NETWORK EQUIPMENT

- A. The Access Layer networking equipment shall be located in the identified telecommunications rooms on the contract drawings to support end user equipment.
- B. Access Layer Switch Equipment – Specific Parts and Pieces
 - 1. PGD Network equipment obtained from an Approved or Equal Vendor in order to provide the following network specifications: Reference Model: C9300-48P-A
 - a. 48 x 1Gbps PoE+ (30W), 8 x 10Gbps SFP+ Uplink Module, 256 Gbps Total Switching Capacity
 - 1) Primary Power Supply: 1100W Active PoE+ External PSU
 - 2) Redundant Power Supply: 1100W Secondary PoE+ Ext. PSU

- 3) Network Uplink Module: 2 x 10Gb SFP+ Connectivity Minimum
- 4) 10 Gbps SFP+: Supports Single-Mode Fiber (G.652)
- 5) Feature Support: Standard Layer 2 Functions, Routed Access (RIP, EIGRP Stub, OSPF (1000 routes)), PBR, PIM Stub Multicast (1000 routes), PVLAN, VRRP, PBR, CDP, QoS, FHS, 802.1x, Macsec-128, CoPP, SXP, IP SLA Responder, SSO

C. All equipment licensing shall be procured and assigned to the designated PGD IT Representative.

2.4 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.5 GROUNDING

- A. Comply with requirements in Section 27 05 26 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
- B. Comply with TIA-607-B.

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor shall install all system components including furnished equipment, and appurtenances in accordance with the manufacturer's instructions, NFPA 70, ANSI-C2 and as shown, and shall furnish all cables, connectors, terminators, interconnections, services, and adjustments required for a complete and operable system.
- B. Grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.
- C. The Contractor's Quality Assurance Inspector shall conduct a visual inspection of all installations to verify that the installations are in accordance with the PGD's and manufacturer's specifications. Records of the inspections signed and dated by the Quality Assurance Inspector shall be provided to the PGD Representative. The PGD Representative shall be notified by the Contractor of any inspection(s) and the PGD Representative may elect to participate in any inspection(s).
- D. All software/firmware/support information must be issued and held in the name of the Owner, not the Contractor.

3.2 CYBER SECURITY REQUIREMENTS

- A. The Contractor must obtain a copy of the manufacturer's cyber security hardening guide and implement the recommendations on all products installed as a part of this project.
- B. The Contractor must comply with the requirements of ISO 27001/27002 for all products installed on this project

- C. The Contractor must comply with the Owner's established cyber security policies for all products installed on this project.

3.3 HARDWARE INSTALLATION

- A. Design plans for hardware selection, installation location, and installation details shall be provided for PGD Representative's approval.
- B. Installation of hardware shall be coordinated with the PGD Representative.
- C. The Contractor shall ensure the ventilation requirements for all hardware components are met.
- D. The Contractor shall install and inspect all hardware required to fully meet the functional, operational, and performance requirements of this Section. Installation of hardware shall be in accordance with the manufacturer's installation instructions.
- E. Retain "Grounding" Article below if specifying conductive fiber-optic cable or fiber-optic cable with a shield or conductive jacket.

3.4 GROUNDING

- A. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."
- B. Comply with TIA-607-B and NECA/BICSI-607.

3.5 SPARE PARTS

- A. The Contractor shall provide 10% field replaceable spare SFP parts with a minimum of one of each type of device. The devices are to be stored on site in a secure location. If the parts are used as advanced replacement during a Warranty service request, they shall be replaced by the contractor within (3) three days at no charge to the Owner. Non-SFP equipment does not require 10% field replaceable spare parts.

3.6 IDENTIFICATION

- A. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with equipment exterior color but still comply with TIA-606-B requirements.

3.7 QUALITY CONTROL

- A. Test Plan/Procedure: The Contractor shall develop and submit a comprehensive Network Test Plan that has been coordinated with the PGD Representative for testing of the network to the Project Manager or Representative for review and approval 30 days prior to the beginning of any testing activities. The test plan shall detail the objectives of all tests. The tests shall clearly demonstrate that the system and its components fully comply with the requirements specified herein.

- B. Contractor shall provide full staff and equipment support to the PGD Representative during testing of the network. This support shall include failover testing for all uplinks, pre-emptive fail back and testing of uplink bandwidth utilization. Support shall include provision of two (2) network technicians with Professional and/or Expert Level certifications for a period of at least two weeks.
1. Test Reports: The Contractor shall submit for each test, a test report document that shall certify successful completion of that test. Submit for review and acceptance within seven (7) days following each test. The test report shall contain, at a minimum:
 - a. Commentary on test results.
 - b. A listing and discussion of all discrepancies between expected and actual results and of all failures encountered during the test and their resolution.
 - c. Complete copy of test procedures and test data sheets with annotations showing dates, times, initials, and any other annotations entered during execution of the test.
 - d. Signatures of persons who performed and witnessed the test.
 - e. Test Resolution: Any discrepancies or problems discovered during these tests shall be corrected by the Contractor at no cost to the Owner. The problems identified in each phase shall be corrected and the percentage of the entire system re-tested determined by the Design Consultant, before any subsequent testing phase is performed.
 2. Termination
 - a. Performance verification test shall be terminated when:
 - 1) Individual components, subsystems, or the integrated system fail to perform as specified
 - 2) It is determined that system is missing components or installation is not complete.
 - b. Upon termination, corrective work shall be performed, and performance verification test rescheduled with the PGD Representative.
 - c. Retesting shall be performed by Contractor at no additional expense.
 - d. The Contractor shall continue to perform corrective actions and retest until system passes all tests to satisfaction of the PGD Representative and the Project Manager or Representative.
 1. Final Inspection and Acceptance
 - a. After testing is complete, review tabulated records with the PGD Representative
 - b. The Contractor will not be responsible for failures caused by:
 - (1) Outage of main power in excess of backup power capability provided that automatic initiation of all backup sources was accomplished, and automatic shut-downs and restarts of systems performed as specified.
 - (2) Failure of any Airport furnished power, communications, and control circuits provided failure was not due to Contractor furnished equipment, installation, or software.
 - (3) Failure of existing Airport equipment provided failure was not due to Contractor furnished equipment, installation, or software.

END OF SECTION 27 21 00

DIVISION 28

SECTION 28 13 00 - PHYSICAL ACCESS CONTROL SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Provide work specified but not shown on Drawings, and work shown on Drawings but not specified, as though expressly required by both.
- C. All sections of Division 26, 27 and 28.

1.2 SUMMARY

- A. This section includes the performance requirements for the Physical Access Control System (ACS) being provided under this project for use at Punta Gorda Airport.
- B. This project will involve the furnishing of all labor, equipment and materials as required for providing a fully operating Physical Access Control System (ACS) which meets the functional, operational and performance requirements described in this specification. This shall include, but not be limited to providing access control, intelligent field panels, door controls, and card readers. The contractor shall also program, integrate and test the system and provide user/administrator/maintenance training.
- C. Punta Gorda Airport utilizes an existing ProWatch ACS. All new components, equipment, controllers, reader boards, shall be fully compatible with the existing operations, software, and hardware.
- D. System operability and proper installation shall be verified through a comprehensive Quality Control Program that includes scheduled inspections and successful completion of acceptance testing and endurance testing.
- E. The ACS is currently not integrated with the Avigilon VMS.

1.3 REFERENCES

- A. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.
- B. Conflicts
 - 1. Between referenced requirements: Comply with the one establishing the more stringent requirements.
 - 2. Between referenced requirements and contract documents: Comply with the one establishing the more stringent requirements.
- C. The Access Control System (ACS) shall be installed in accordance with the most current version of the following:

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1. Building Industry Consulting Services International (BICSI): "Telecommunications Distribution Methods Manual" (TDMM).
2. "Recommended Security Guidelines for Airport Planning, Design and Construction" – Program for Applied Research in Airport Security (PARAS)/Safe Skies
3. CFR 49 Part 1542
4. RTCA DO-230 Airport Access Control Systems
5. Americans with Disabilities Act.
6. All applicable state and local building codes
7. American Society Industrial Security (ASIS) Protection of Assets Manual.
8. Accepted industry best practices.
9. Manufacturer recommended installation guidelines.

1.4 PRODUCT STANDARDS

- A. Provide at the time of installation the latest Commercial-Off-The-Shelf (COTS) version of all equipment. Discontinued or prototype equipment shall not be acceptable. The features described in this specification shall be part of a standard offering of features which shall only require configuration to enable the functionality described herein.
- B. Provide equipment suitable for the purpose for which it was manufactured. Field modifications made to adapt equipment for purposes other than what it was manufactured shall not be permitted.
- C. Products must be fully compatible with Honeywell ProWatch software and hardware as specified within this document.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be delivered to the job site in original packages with labels intact and identification clearly marked. The equipment shall be made available to inventory by the Airport should they choose when delivered to the site. Equipment and components shall be protected from the weather, humidity, temperature variations, dirt, dust, or other containments at all times. Equipment experiencing damage prior to initial installation shall be replaced at no cost to the Owner.

1.6 WARRANTY

- A. Provide a one (1) year warranty on the Work and all equipment and software provided as new under this contract. If, within one (1) year after the date of Final Acceptance of the Work or by the terms of any applicable special warranty provided by the manufacturer, any of the Work, equipment or software is found to be defective or not in accordance with the Contract Documents, the Contractor shall correct it promptly including all parts and labor after receipt of notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such defective conditions. The Owner will give such notice promptly after discovery of the condition. Such notice shall be provided by Owner representatives, to be identified in writing.
- B. Warranty Service: In the event that defects in the equipment, software or workmanship are identified during the Warranty period, the Contractor shall provide all labor, travel expenses and materials as may be required for prompt correction of the defect at no additional charge to the Owner.
- C. During the Warranty period, the Contractor shall, upon receipt of a request for service from the Owner, deploy service personnel to the Owner's premises within the required response time described below and

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complete corrective action within twenty-four (24) hours of arriving on site. Corrective actions which cannot be completed within twenty-four (24) hours must be approved by the Owner.

- D. Repair or replacement service during the warranty period shall be performed in accordance with the following schedule:
 - 1. Seven (7) days, twenty-four (24) hour, three hundred sixty-five (365) days a year: two (2) hour on-site response time shall apply for major system failure. A major system failure is defined as a failure that causes multiple portions of a system to be unable to perform the task for which it was intended or creates a potential for an immediate security breach.
 - 2. Next business day response time shall apply for minor component and device failures.
 - 3. The Owner shall be the sole authority to define a failure as a major or minor system failure.
- E. If the Contractor is unable to restore system operation during the warranty period within twenty-four (24) hours of a reported failure, the Owner reserves the right to require the Contractor to provide on-site manufacturer's service technicians at no additional cost.
- F. The Contractor's Warranty obligation shall include providing an Extended Software Support Agreement for the entire construction and warranty period. The Software Support Warranty is intended to have all patches, updates or upgrades installed promptly by the Contractor at no charge so that at the end of the Warranty period all software including but not limited to applications, operating systems and databases are at the most current release level. At no time shall the installed software be at a revision level less than that which is currently available for new installations.
- G. The agreement shall include any training for any changes in operation of the ACS application required by updated software.
- H. Prior to any software update or installation, the contractor shall make full back-up copies of the installed software being upgraded such that should the upgrade prove to be problematic, the system can be easily rolled back to the previous version.
- I. Immediately following the completion of a Warranty repair or service call, the Contractor's service personnel shall submit a written report to the Owner which details the service work performed, the cause of the trouble, and any outstanding work which is required to restore complete and normal operation.
- J. As part of the warranty, the Contractor shall perform preventative maintenance as required by the manufacturer to keep the warranty in force during the warranty period. The Contractor shall submit a list of manufacturer required items to be included in the preventative maintenance program. The list shall include maintenance to each item, the frequency of such maintenance, and the amount of time to be spent on each item for maintenance. At a minimum, all servers and workstations shall be cleaned and inspected every six-months after final acceptance; all portals, power supplies and batteries will be checked for proper operation every three-months starting from the date of final acceptance for the Project.
- K. The Owner reserves the right to expand or add to the system during the warranty period using firm(s) other than the Contractor for such expansion without affecting the Contractor's responsibilities on the components originally provided by them, under the condition that the expansion is done by the Owner's trained staff or a firm which is an authorized dealer or agent for the equipment or system being expanded.

1.7 TRAINING

- A. The contractor shall provide the Owner's staff with training to certify them to the same manufacturer's

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certification level as the contractor.

1. Training shall be provided for information technology staff to the level necessary to administer and configure the system.
 2. Training shall be provided for maintenance technicians to allow them to service the system.
 3. Training shall be provided operators monitoring the system.
- B. Training will need to be arranged to support staff members on their various shifts including those working after normal business hours.
- C. Training shall be conducted on-site using the equipment provided by this project prior to substantial completion. If additional workstations are required to accommodate the training, the Contractor must loan the Owner such additional equipment to facilitate the training.
- D. Coordination with the Owner on the training schedule and subjects to be covered is required.
- E. This training shall not relieve the contractor of any obligations to repair the system under the warranty when notified by the Owner that a malfunction has occurred and requires their service.
- F. The contractor shall provide up to an additional eight (8) hours of on-site re-training time during the warranty period should the Owner's staff request a refresher course during the warranty period.

1.8 TESTING

- A. All of the Contractor's Work shall be tested and inspected by the Owner's Representative including the Designer for full compliance with the Specifications. The Contractor shall coordinate and cooperate fully and shall provide at no additional cost to the Owner, manpower, blueprints, radios, facilities, etc. to reasonably assist the inspectors.
- B. Testing shall occur in two phases. The first phase will be a functional and physical inspection of the installation. All faults found in this first phase will be corrected prior to the advancement to the second phase.
- C. The second phase of testing shall be a reliability test. The installed systems shall operate for a period of not less than thirty (30) days without a malfunction. If a malfunction is identified during this period it shall be promptly corrected and the reliability test period start over again and run for another thirty (30) days unless restarted again by another malfunction. The Final Acceptance Certificate will only be issued after thirty (30) days of continuous use without experiencing a malfunction during the second phase of testing.

1.9 QUALITY ASSURANCE

- A. Contractor must be certified at the highest level by the software and hardware manufacturer of the system being proposed by the Contractor.
- B. Contractor must have all of the necessary licenses to install security equipment required by authorities having jurisdiction.
- C. UL Compliance and labeling: Provide system components that are UL-listed and labeled.

1.10 ACTION SUBMITTALS

- A. General: Partial submittals are not acceptable. Submit all documentation in accordance with the established Submittal Procedures as well as this section. Where there is a conflict the more stringent will apply.
- B. Qualification Data: Provide documentation demonstrating that the Security Contractor is certified at the highest level by the software and hardware manufacturer being provided for this project and that all of the staff providing installation and programming of the system are similarly certified. All certifications must

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be current. Failure to meet this qualification can result in the Security Contractor being disqualified for performing the services described in this specification section.

C. Product Data must include the following:

1. Submit manufacturer's data on System components including, but not limited to, electrical specifications, physical specifications, and instructions for installation, operation, and maintenance.
2. Equipment schedules listing all system components, the manufacturer, model number and the quantity of each along with a general functional description for each system component.

D. Test plan: Security Contractor is to provide a comprehensive test plan for approval by the Engineer to demonstrate that the ACS has been installed in accordance with the applicable sections of the related documents section of this specification and that all required features and functionality are demonstrated to the satisfaction of the Airport.

E. No portion of the Work will commence, nor any equipment be procured, until the Engineer has approved the Product Data Submittals.

1.11 Shop Drawings:

1. Prepare Shop Drawings by persons with the following qualifications:
 - a. Trained and certified by manufacturer in ACS design.
 - b. Licensed or certified according to the requirements of the authorities having jurisdiction.
2. Floor and site plan drawings indicating individual device locations with device legends indicating manufacturers and model numbers for each device.
3. System riser diagram showing all devices, wire runs and wire designations.
4. Schematic block diagrams for each system showing typical equipment interconnection and basic component functionality, etc.
5. Wiring diagrams for each system defining the interconnection of all inputs and outputs for all equipment.
6. Identification of power distribution panels and circuit numbers providing 120V/208V power to equipment.
7. Battery Calculations: Security Contractor shall submit load calculations confirming four (4) hour back-up runtime is attainable with the quantity and size of batteries provided.
8. Dimensioned floor plan and elevations of equipment racks, control panels and wiring diagrams
9. Detail fabrication and assembly of the following:
 - a. ACP enclosures.
 - b. Door hardware interface diagrams
 - c. Graphic alarm maps

1.12 INFORMATIONAL SUBMITTALS

A. Security Contractor must provide weekly field quality-control reports and schedule updates to the Engineer.

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1.13 CLOSEOUT SUBMITTALS

A. Record Drawings

1. Record Documentation shall consist of “As-Built” Drawings produced from the hand marked field documents and Operation and Maintenance Manuals. The Record Documentation shall be submitted to the Project Manager within forty-five (45) days after final acceptance.
2. Produce all Record Drawings using the latest version of AutoCAD/REVIT. Record Drawings shall, at a minimum, include the following:
 - a. Floor plan drawings indicating device locations, with device legends indicating manufacturers and model numbers for each device.
 - b. Floor plan drawings indicating wire routing. Wire routing shall be delineated in straight line runs and be tagged with cable identification and terminal strip numbers to coincide with the installation.
 - c. Mounting details for all equipment and hardware.
 - d. Functional block diagrams for each subsystem.
 - e. Wiring details showing rack elevations, equipment wiring and terminations, and inter-rack wiring.
 - f. Wiring diagrams for all custom circuitry including interfaces to various control output-controlled devices, i.e., overhead doors, automatic sliding doors, parking gate operators, fire alarm system interface, etc.
 - g. Wiring diagrams for each field panel (ACP). Wiring diagrams shall be identical to those laminated and located with each ACP.
 - h. Typical point-to-point wiring diagrams for each piece of equipment and groups of equipment within the system.
 - i. Layout details for each riser location, including security panels, power supplies, junction boxes, conduit, and any other security related equipment.
 - j. Provide three (3) sets of drawings in hardcopy, coordinate with Owner on exact sheets size (1/2 or full size). Provide copy of drawings in electronic (pdf) format on a USB drive.

B. Operation and Maintenance Manuals:

1. The maintenance manual requirement of this Section is in addition to Shop Drawing requirements. Maintenance manuals and drawing sets shall be compiled after system fabrication and testing and shall incorporate any changes made after Shop Drawing submittal. The maintenance manuals and drawing books shall be permanently bound in hard plastic covers.
2. It is intended that the operation and maintenance manuals be exhaustive in the coverage of the system to the extent that they may be used as the sole guide to the troubleshooting, identification, and repair of defective parts. Provide wiring diagrams showing all field installed interconnecting wiring. Wire identification on the diagrams shall agree with the wire markers installed on the equipment. Provide component identification and cross reference on the Drawings to allow the maintenance department to understand the function of each item (the block diagram), find the location where the device is mounted (floor plans), find its location in an equipment enclosure (arrangement drawings), find how it is wired (wiring diagrams), and its detailed Specifications (vendor data sheets), and how to repair it (spare part lists).
3. Manufacturer's Literature: Provide manufacturer's standard literature, covering all equipment included in the system. The maintenance manuals shall contain Specifications, adjustment procedures, circuit schematics, component location diagrams, and replacement parts identification. All references to equipment not supplied on this Project shall be crossed out.
4. Operation and Maintenance Manuals shall apply to all security related devices, equipment, and software modules.
5. Power-up and power-down procedures for each subsystem.
6. Description of all diagnostic procedures.

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7. A list of manufacturers, their local representatives and subcontractors that have performed Work on the Project. The list shall include contact names, phone numbers and addresses for each.
 8. Installation and service manuals for each piece of equipment.
 9. Maintenance schedules for all installed components. Schedules shall include inspections and preventative maintenance schedules, and documentation of all repaired or replaced equipment.
 10. Provide three (3) sets of manuals in bound hardcopy form. Provide copy of manuals in electronic (pdf) format on a USB drive.
- C. Warranty: Statement of warranty in electronic (pdf) form.

1.14 INTELLECTUAL PROPERTY

- A. Patents: Should patented articles, methods, materials apparatus, etc., be used in this work, the Contractor shall acquire the right to use patented materials. The Contractor shall hold the Owner and its agents harmless for any delay, action, suit, or cost growing out of the patent rights for any device on this project.
- B. Copyrights: Should copyrighted software be used in this work, the Contractor shall acquire the right to use copyrighted software. The Contractor shall hold the Owner and its agents harmless for any delay, action, suit, or cost growing out the copyrights for any software on this project.
- C. License to use: All software required for the complete operation of the system as specified herein shall be delivered with full ownership transferred to the Airport with a non-time-limited license to use on each machine it is installed on, including the right to make back-up copies.

1.15 RADIO/TELEVISION INTERFERENCE

- A. Expected RF Environment: This security system shall be installed in an airport and will be subject to background RF levels which are expected in such an area. It is the Contractor's responsibility to protect the system specified here from interference to and by other systems.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. Access Control System (hardware, controllers, and modules):
 - a. Honeywell ProWatch
 - b. No Substitutions
 2. Card Readers (with and w/o Keypad):
 - a. HID
 - 1) RP40, RPK40, RP15, RP10
 - b. Approved Equivalent
 3. Magnetic door position switches:

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- a. Magnasphere
 - b. Approved Equivalent
- 4. Power Supplies (for controller, module, and door hardware):
 - a. Altronix
 - b. Life Safety Power
 - c. SDC
 - d. Securitron
 - e. Approved Equivalent
 - f. Honeywell
- 5. Visual and/or Audible Devices:
 - a. System Sensor
 - b. Wheelock
 - c. Approved Equivalent

2.2 SOFTWARE REQUIREMENTS

- A. The Physical Access Control System shall be a modular and network-based access control system. The System shall be capable of controlling multiple buildings, alarm monitoring, ID badging, and allow for easy expansion or modification of inputs and outputs. The Access Control System must be based on client-server architecture and shall be under the control of a single software program providing full integration of all components. It shall be user configurable at any time depending upon facility requirements. Access Control System reconfiguration shall be accomplished through system programming on a workstation. The Access Control System shall include the following:
 - 1. Multi-User/Network Capabilities: The Access Control System shall support multiple operator workstations via local area network (LAN). The communications between the workstations and the server computer shall utilize the TCP/IP standard over industry standard IEEE 802.3 (Ethernet). Standard operator permission levels shall be enforced, with full operator audit.
 - 2. Concurrent Licensing: The Access Control System shall support concurrent client workstation licensing. The Access Control System application shall be installed on any number of client workstations and shall provide the ability for any of the client workstations to connect to the database server as long as the maximum number of concurrent connections purchased has not been exceeded.
 - 3. Security Key: The Access Control System shall only require a software security key to be present on the application server for the Access Control System to operate. Security keys shall not be required at the client workstations. The Access Control System shall allow a user to read the information that is programmed on the server security key. The Access Control System shall support the installation, update, and termination of the security-key.
 - 4. Access Control Software Suite: The Access Control System shall offer an Access Control software suite which must include a complete access control solution, alarm monitoring and ID badging.
 - 5. Encryption: The Access Control System shall provide multiple levels of data encryption
 - a. True 128-bit AES data encryption between the server and intelligent controllers as well as between the server and the workstations. The encryption shall ensure data integrity that is compliant with the requirements of FIPS-197. Master keys shall be downloaded to the

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- intelligent controller, which shall then be authenticated through the Access Control System based on a successful match.
 - b. Transparent database encryption, including log files and backups.
 - c. SQL secure connections via SSL
- 6. Compliance and Validation: The Access Control System shall incorporate authentication where modifications to Access Control System resources will require either a single or dual authentication. Administrators will have the ability to select specified devices in the Access Control System where data manipulation will be audited, and authentication will be required to account for the data modification. Upon resource modification, the user will be required to enter a reason for change or select a predefined reason from a list. All data will be securely stored and maintained in the database and can be viewed using the reporting tool. This functionality will meet the general requirements of Validation and Compliance through Digital Signatures with special attention to the case of Title 21 CFR Part 11 Part B compliance.
- 7. System Operations:
 - a. Windows Authentication Login: The Access Control System shall use an integrated login method which accepts the user ID of the person who has logged on to Windows.
 - b. Password: The Access Control System shall use an integrated authentication method which utilizes Windows user accounts and policies.
 - c. Information Access: The Access Control System shall be capable of limiting operator access to sensitive information. Operators must have proper authorization to edit the information.
 - d. Shadow Login: The Access Control System shall allow users to login over a currently logged-on user without having the current user log off the Access Control System or out of the Windows operating system.
- 8. Graphical User Interface: The Access Control System shall be fully compliant with Microsoft graphical user interface standards, with the look and feel of the software being that of a standard Windows application, including hardware tree-based system configuration.
- 9. Secure Mode Verification (e.g., force workstation operator to do a visual verify): The Access Control System must provide 'secure mode' control option from the verification viewer. This shall allow a workstation operator to decide the access of an individual who presents his/her card at a designated secure mode reader by comparing a live video image from a camera at a portal with the credential photo stored in the system.
- 10. Cardholder Initiated Extended Alarm Shunting: The system must be configured to allow a cardholder using a numeric keypad on a card reader to be able to dynamically change the door held open alarm time to permit selected doors to be held open for passenger boarding operations without initiating a door held open too long alarm. The allowable time limits must be Owner defined to limit the amount of time the cardholder can extend the time and be adjustable from five minutes to forty-five minutes. The card reader must provide a visual indication that the door has been placed in the extended time mode. The card reader must be able to provide a visual and audible means of indicating the extended timer is about to expire so that the cardholder may close the door prior to a door held open too long alarm being initiated.
- 11. Database Partitioning: The Access Control System shall support dynamic partitioning. Access Control Systems in which partitions are set up at installation and cannot be easily changed shall not be acceptable. The system must provide for an unlimited number of user defined fields, all of can be included in searching and reporting functions integral to the application.
- 12. Status Groups: The Access Control System shall support a real-time system status monitor that graphically depicts all logical devices.
- 13. Automatically Disable Card upon Lack of Use: The Access Control System must allow system operators to set a predefined time period in which cardholders must use their card on a system card reader in the Access Control System in order for the card to remain active.
- 14. User Functions and ADA Ability: The Access Control System shall provide user functions and ADA (Americans with Disabilities Act) compliance that provides the capability to trigger an event

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- at the Access Control System intelligent controller when a defined card is presented such as initiating a motorized door operator or providing an extended door open time to allow passage.
15. Pathways: The Access Control System shall support the capability of programming pathways. A pathway shall be an object that combines input points to be shunted for a set duration, and an output point to be activated, when a particular card receives a local grant at a reader.
 16. Database Audit Log: The Access Control System shall be capable of creating an audit log in the history file following any change made to the Access Control System database by an operator.
 17. Operator Log: The Access Control System shall be capable of creating an action log in the history file following actions performed by an operator.
 18. Alarm Routing: The Access Control System shall be capable of defining routing groups that determine what event information shall be routed to a user or class of users.
 19. In addition to alarm and trouble information being displayed on the ACS workstations, the information must also be able to be routed to staff members via SMTP e-mail connection as well as SMS text messages to designated cell phones.
 20. Hardware Templates: The Access Control System shall include the ability to define hardware templates (door templates) in order to simplify the process of creating an access control system. Hardware templates shall allow a user to define a “typical” door configuration and then use that template over and over in the process of defining doors.
 21. Access Control Functional Requirements: Functions shall include validation based on time of day, day of week, holiday scheduling, site code verification, automatic or manual retrieval of cardholder photographs, and access validation based on positive verification of card/PIN or card. The following features shall be programmable and shall be capable of being modified by a user with the proper authorization:
 - a. Time Zones: Shall define the period during which a reader, card, alarm point, door, or other system feature is active or inactive. In addition to Monday-Sunday, there shall be at least one day of the week called Holiday.
 - b. Holidays: The application shall allow holidays to be entered into the Access Control System. Holidays shall have a start date plus duration defining multiple days. Holidays shall have a holiday type of 1, 2, or 3, which may be defined by the user.
 - c. Response Codes: The Access Control System shall allow the user to enter a predefined code to represent a response to an alarm occurring in the facility.
 - d. Clearance Codes: The Access Control System shall allow the user to establish groups of readers at a facility for the purpose of granting or denying access to badge holders. Clearance codes shall be assigned to companies and individuals employed by the company and may be modified for individual users in the badge holder maintenance application.
 - e. Companies: Each badge holder entered into the Access Control System shall be assigned a company code identifying the individual’s employer. The company information dialog box displays and maintains information related to companies having access to the facility.
 - f. Group Access: The Access Control System shall allow a user or group of users via company selection, a temporary denial of access to specific readers or areas based on a preconfigured event. The group access function shall limit access to a group of cardholders, overriding all other access criteria.
 - g. Events: The event editors shall control processing done at the host computer that allows the user to associate nearly any input (trigger) with almost any sequence of outputs (actions) that the Access Control System is capable of executing.
 - h. Alarm Pages: Access Control System shall include the capability to create an unlimited number of customized alarm pages for the alarm monitor and each shall be assignable to users and user classes.
 - i. Event Types: Definitions shall be shipped with system software but shall be capable, upon installation, of being modified, added to, or deleted from the Access Control System.
 - j. Dynamic Graphical Maps: The Access Control System shall provide the user with the means to add maps and indicator icons to maps that shall represent input/output points, logical devices, or cameras located throughout the Access Control System. Access Control System

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- maps shall display the state and condition of alarm points. The Access Control System shall also provide the ability to monitor the channels or panels.
- k. Brass Keys: Shall maintain information related to assets that are issued in the facility, including brass keys, laptops, radios, cell phones, company cards, etc.
22. The Access Control System shall maintain information related to a badge holder access privileges. Upon entering this application, a window shall appear on the screen and all actions (add, modify, or delete) involving badges and cards shall be initiated from this window. The interface shall operate similar to a “Microsoft Wizard” application. Access privileges shall be linked to the cards used to gain access to doors in the facility. Modifications shall be made by adding or deleting clearance codes, or by door types assigned to the cards or to a badge holder. The Access Control System ID badging client shall be seamlessly integrated with the ACS workstation client. It is required that the ID badging software be part of to the ACS platform.
23. The ID badging client must be able to connect to and manage fingerprint information from online transportation clearing houses and process security threat assessments and “Rap Back” information through the clearinghouse. The badging system must integrate with the live scan fingerprint capturing system provided by the Security Contractor so that the personal identification information data entry occurs only once throughout the connected systems. The intent is to provide this function as part of the ACS software and not a 3rd party Identity Management System software.
24. Users: Information related to the users of the Access Control System software shall be stored in the database. Users entered into the Access Control System shall be assigned the access privileges of the class to which they are assigned.
25. Generic Channel Interface: The Access Control System shall provide the ability to define generic communications channels over serial port or TCP/IP network socket including IP address and port/socket, to support custom integration of external foreign devices such as a Video Management System. The Access Control System shall generate events based on data received from the channel matching operator pre-defined instructions as well as send events based on pre-defined instructions generated by the Access Control System.
26. Event Manager: The Access Control System shall utilize an event manager as a component of system administration and offer the ability to have users control the amount of data stored as well as a quick snapshot of the logged data in the system. Using the various logs in event manager, the user will be able to gather information about events, auditing, and operator actions. The logs are defined as follows: Event log, audit log, unacknowledged alarms.
27. The system must include built-in financial reporting capabilities. The system shall track violation revenue as well as fees collected for badge application processing and print out pro-forma invoices for processing by the Owner’s external financial system. A direct data exchange between the ACS and the financial system is not desired.
28. The system must include the ability to manage vehicle permits and insurance information on vehicles which are authorized to operate on the Airport. The system must also manage training and certifications related to a credential such that training/certifications that are expired can disable access privileges associated with the training/certification.
29. The System shall include a report creation program fashioned after “Microsoft Wizard” applications. The application shall operate in a pick-and-choose anything environment. The report output format must be able to be rearranged and sorted via a click, drag-and-drop interface. The report generation program must be integral to the ACS application. Third-party report creation applications are prohibited. The system must be able to provide pre-formatted TSA badge history reports.
30. Document Management Module: ACS shall be able to maintain any number of documents for a badge holder or company. Stored documents shall be any paper, electronic on a file system or a link such as a web page. Paper documents should be able to be scanned as images or PDF’s. PDFs should be scanned as a single or multiple documents. Documents can be viewed and printed at any time for any badge holder and become part of their electronic record.

- B. The existing system is Honeywell ProWatch. Installation under this contract shall not include updating the existing system, except where needed to install new doors, readers, IC board and reader boards. Contractor shall provide any new license, expansions, upgrades, hardware and software, as required to install new reader and doors.

2.3 SYSTEM INTERFACES

- A. Video Management System
 - 1. The existing Video Management System is not currently integrated. VMS / ACS is not part of the existing system requirements.
- B. Door Hardware
 - 1. Where fail-safe door hardware is used, the ACS must interface with the fire alarm system to automatically unlock doors in the egress path for the zone where the fire alarm is occurring. The Security Contractor must coordinate with the Fire Alarm system provider to install door release relays either within three feet of the door or the door lock power supply locations to release the door locks in the egress path where the fire alarm is occurring.

2.4 ACS FIELD HARDWARE

- A. Intelligent Field Panel: It is the intent of these specifications to intentionally limit the Intelligent Field Panels to the following models to provide the Airport with a platform which is compatible with the existing Honeywell ProWatch system
 - 1. Modular Panel Enclosure
 - a. PW5K2ENC1 High Density Enclosure
 - 2. Authentic Honeywell Intelligent Controller (Compatible with existing Software)
 - a. PW-6000 Series or latest technical equivalent
 - b. PW-3000 Series or latest technical equivalent
 - 3. Authentic Honeywell reader boards for use in the High-Density Enclosure:
 - a. PW6K1R2 – Two reader board
 - b. Or approved equivalent.
 - 4. The ICPs shall collect alarm input point status and access control data, multiplex the information, and transmit that data back to the ACS file server / system workstations.
 - 5. The ICP shall incorporate Flash ROM to allow for efficient firmware update downloads from the system software and/or remotely from the ACS System manufacturer.
 - 6. The ICPs shall receive and execute instructions issued automatically or manually from the ACS file server / system workstation.
 - 7. The ICPs shall have memory and logic circuits as required to ensure continued operation of connected devices without degradation in system security in the event that communications with the ACS file server is interrupted.
 - 8. All system ICPs shall communicate with the ACS file server over the Security VLAN.

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9. ICPs shall be located in telecommunication or electrical rooms as indicated on the Drawings, and shall be wall mounted, as indicated on the Drawings. Door Interface Boxes shall not contain ACS electronics. Refer to Door Interface Box details on the drawings.
10. A tamper switch shall be installed to sense the opening of the ICP Enclosure door and shall be connected as an alarm input to the ACS.
11. The ICPs shall provide the following:
 - a. Supervised alarm inputs to monitor the status of alarm circuits and report the status information to the ACS file server.
 - b. Control relay outputs for controlling devices by remote command from the ACS workstations, through time programming or on alarm point activation date on the ACS server. Control relay output contacts shall be rated for 2 A @ 24 VDC.
 - c. Flash ROM technology and shall provide for remote update of ICPs firmware.
 - d. Four state (open contact, closed contact, cut wire, and shorted wire) supervision of all wiring / circuits between the ICPs and monitored alarm devices.
 - e. Enough RAM to maintain a minimum card database of 5,000 cards.
 - f. Automatic disconnection from the communication circuit upon a communication failure within the ICPs to prevent communication to other ICPs in the circuit from being interrupted.
 - g. Enough RAM to operate normally upon loss of communication with the ACS file server. In addition, the ICPs shall store up to 5,000 card transactions and up to (16) events per potential alarm input and transmit that data to the ACS System file server as soon as communication is restored.
 - h. Activation of a door control relay output and shunting of the intrusion alarm upon verification of a card authorization or request to exit.
 - i. Adjustable door control relay activation time through ACS System Software from 1 to 30 seconds on an individual card reader basis. The door shall automatically relock upon closure.
 - j. An intrusion alarm indication on the ACS System if the card reader controlled door is opened without an authorized card use or request to exit.
 - k. A door prop alarm indication if the card reader controlled door is held open past an adjustable time period after an authorized card use or request to exit. The door prop time delay shall be adjustable through ACS System Software from 1 to 60 seconds on an individual card reader basis.
 - l. A wiring chart delineating wire routing, labeling, and all termination points. The chart shall be produced by the Contractor, laminated, and housed in a clear plastic sleeve affixed to the inside of the enclosure cover.
 - m. A tamper switch to sense the removal or opening of the enclosure cover.
 - n. Transaction time for authorized cards shall be less than 0.5 second from the time of card read until the door is unlocked.

B. ICP Power Supply

1. Certifications: UL Class II power limited, ULC 294/1076, CSA, CE
2. Input Power: 120VAC, 60Hz.
3. Output Power: Regulated and filtered 13.8VDC, 3.75A.
4. Battery backup: Provide sufficient sealed gel type re-chargeable battery backup to power the ICP connected to that ICP for a period of not less than four (4) hours.
5. Report the following conditions via IP connection for transmission of trouble signal to system head-end:
 - a. AC Fault on blown fuse
 - b. Low/Defective Battery
6. Diagnostic LEDs for power and blown fuse indication.
7. ICP power supplies must not be used to also power door locking devices.
8. Cabinets shall be lockable and provided with tamper switches. Provide signage warning that an alarm will sound if access is attempted.
9. Provide permanent identification label, black micarta nameplate with white lettering.

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C. Multi-Output Door Hardware Power Supply

1. The security integrator shall be responsible for interfacing the lock power supply to the locking mechanism. Provide all cabling and electrical connectors as required.
2. Provide power supplies with the following characteristics:
 - a. Input power 120VAC.
 - b. Battery backup: Provide sufficient battery backup to power the locks connected to that ICP for a period of not less than 4 hours.
 - c. Output power eight (8) individually fused 12 or 24VDC outputs for lock power.
 - d. Report the following conditions via IP connection for transmission of trouble signal to system head-end:
 - 1) AC Fault on blown fuse
 - 2) Low/Defective Battery
 - e. Door hardware power supplies must not be used to also power ICP.
 - f. Diagnostic LEDs for power and blown fuse indication.
 - g. Cabinets shall be lockable and provided with tamper switches. Provide signage warning that an alarm will sound if access is attempted and giving the telephone number of the security monitoring desk.
 - h. Provide permanent identification label, black micarta nameplate with white lettering.

D. Card Reader with Integral Keypad:

1. HID MultiClass SE Series
2. Encrypted OSDP 2 Communications must be utilized.
3. Must read standard types of high frequency credentials. NFC and Bluetooth must be disabled.
4. Must read existing credentials as use by the Airport.

E. Card Reader

1. HID MultiClass SE Series. Provide mullion mount style where wall mounted readers are not able to be utilized.
2. Encrypted OSDP 2 Communications must be utilized.
3. Must read standard types of high frequency credentials. NFC and Bluetooth must be disabled.
4. Must read existing credentials as used by the Airport.

F. High Security Magnetic Switch: Provide high security magnetic switches at baggage conveyor doors, pedestrian door locations as indicated on the drawings. Switches shall have the following features and characteristics:

1. Construction: Rugged construction designed for surface mounting to door or gate and to the floor.
2. High security: UL 634 Level 2 for interior locations. UL Wide Gap for exterior applications.
3. Contacts: Independent form-C contacts wired in a SPDT configuration.
4. Tamper feature
5. Life expectancy: 10,000,000 cycles.
6. Resistant to permanent contact welding.
7. Rating: Indoor and Outdoor use, encapsulated
8. Surface mounted contacts must be installed with tamper resistant or one-way screws.

G. Request-To-Exit (REX) Pushbutton: When the Request-To-Exit function is not integral to the locking mechanism or an exit card reader is not used; provide request-to-exit (REX) pushbuttons with two electrical circuits for unlocking card reader-controlled doors. One circuit shall be wired directly to the locking device to provide failsafe unlocking of the door. The other circuit shall be wired to the REX input of the associated field panel. Activation of the REX pushbutton shall release the lock and shall shunt the intrusion alarm

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output. The REX pushbutton shall contain an adjustable time delay for the door unlocking time. All REX pushbuttons shall be lighted and meet life safety codes.

1. Manufacturer: Security Door Controls, Inc. #423U or Engineer Approved Equal.
2. Stainless steel, heavy duty type pushbutton and cover plate. Minimum pushbutton diameter shall be 2.5 inches or as required by code.
3. DPDT contacts, rated 4A.
4. Pushbutton color: Green
5. Time-delay: Adjustable from 1 to 30 seconds
6. Trim plate finish: Brushed stainless steel.
7. Rated for outdoor use when installed outdoors.
8. Continuously illuminated with positive visual feedback of successful activation
9. Provide two (2) 27" IPS LCD 4k desktop monitors with fully adjustable tandem mounting arm for each workstation location.
10. ISO/IEC 14443 A 1-4 and 7816 compliant
11. 2kb EEPROM or better
12. 13.56MHz operating frequency
13. Size: CR-80
14. Construction: Composite polyester with polished PVC finish

H. Delayed Egress doors shall be used to provide emergency exit as required for life safety codes. The door shall allow egress upon depressing the exit bar for a preset time as allowed by Federal, State, and local codes.

1. Manufacture: Sargent fail secure delayed egress, 59-85-74-ETL or Engineer Approved Equal
2. Unit shall include fail secure locking hardware
3. Relay output to provide alarm notification to ACS.
4. Audible alarm upon emergency door release
5. Nuisance buzzer on exit bar to prevent accidental release of door.
6. Key cylinder as required for local use.

I. WIRE AND CABLE

1. Refer to Specification Section 280513 Conductors and Cables for Electronic Security for cabling requirements.
2. Refer to ACS Cable Schedule on drawings.

2.5 SURGE AND TAMPER PROTECTION

A. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor-entry connection to components.

1. All inputs shall be protected against surges induced on device wiring. Outputs shall be protected against surges induced on control and device wiring installed outdoors and as shown. All communications equipment shall be protected against surges induced on any communications circuit. All cables and conductors, except fiber optics, which serve as communications circuits from security console to field equipment, and between field equipment, shall have surge protection circuits installed at each end.

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PART 3 - EXECUTION

3.1 INSTALLATION

- A. Manufacturer's Instructions: Install Access Control System in accordance with equipment manufacturer's written instructions and complying with applicable portions of the National Electrical Code.
- B. Field Verification: The Contractor shall be responsible for field verification of existing system, panels, power supplies and installation location.
 - 1. The Contractor shall verify the exact location of conduit routing and ACS controller locations. As a part of this project, the Contractor shall remove any existing equipment, conduit, and wire not used as a part of the updated system. This shall include repair or replacement of any damaged finishes or hardware, including patching as required.
 - 2. If during the field verification phase, it is discovered that an existing device, component or connection point is damaged, unusable or not working correctly, the Contractor shall immediately bring it to the Airport's attentions.
- C. Grounding: All pair shields shall be grounded at one point only. Cables that originate from equipment in Tele-Comm Rooms (TR) and serve field devices shall be grounded to the signal ground terminal in the TR.
- D. Protection: Contractor shall provide protection as required of installed devices to prevent damage until final testing and acceptance. Installed equipment, devices, cabling, etc. that is damaged during the construction process and before final acceptance by Owner shall be replaced by the Contractor at no cost to Owner.
- E. Seismic Ratings and Restraints: Install panels in accordance with Seismic Specification.
- F. The Contractor shall provide all programming, data input, graphical map creation, and system configuration for a fully operational and complete system.

3.2 INSTALLATION OF CONDUCTORS

- A. General: Installation of conductors is specified in Division 280513.

3.3 ACS SYSTEM TESTING

- A. General: The Contractor shall develop a phased testing plan and submit it to Owner's representative for approval. The intent of the test is to demonstrate full functionality to regulate access through a portal under various communication scenarios which may introduce faults into the system.
- B. At a minimum the Contractor's plan shall include a phased testing approach to ensure that the system is capable of operating per the specifications. The tests shall be structured to prove that higher level components are functional prior to connection to lower level components. Successfully complete each testing phase before proceeding to the next level of testing. Any problems discovered during these tests will be documented and brought to the attention of the Owner and corrected at Contractor's expense. The Contractor shall promptly correct all problems encountered, providing field service personnel appropriately trained for the types of problems encountered. Prior to connection of the first portal, the cardholder and door configuration databases must be completely populated, and new badges must have been issued.
- C. System Communications Test: Upon completion of installation and wiring, communications testing may begin. The Host shall be limited to communication with one (1) door at a time for this test. The database

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shall be populated with portal configurations and test cards, which shall be downloaded to each field panel. The test shall include reading each of the test cards at the door under test and observing the door operation and workstation display. Test cards shall be read under two (2) different conditions, with the Host making access decisions and with the field panel making access decisions. The results of the test shall be compared to a printed copy of the transaction log for accuracy. This test should prove basic “no load” communications, upload and download integrity.

- D. Local Test: Upon completion of each portal, download the cardholder and door configuration databases and test each portal device for specified functionality with the test cards. Access requests are to be based on door interface panel decisions and valid site codes with communications to the door interface panel disabled. One (1) of the test cards shall be disabled/enabled during the test. This test should prove the basic integrity of the Portal interface and the wiring and terminations between the Portal Interface and the portal devices. Upon successful completion of the test, the portal shall be in service, controlled by the new ACS system.
- E. Final Test and Acceptance: Upon completion of Local Tests, the system will be operating at normal traffic capacity with the Host in communication with all doors for this test. The test shall include reading each of the test cards at the door under test and observing the workstation display, portal operation and related I/O to connected components. This test should prove “under load” communications, upload and download integrity, I/O functionality, and system logic. After a successful test, the test card data shall be removed from the database. All ACS functions shall be demonstrated to ensure the entire system is operational as required by these Specifications and Drawings. The Contractor shall provide a test schedule including the time and dates. The Owner's representative will observe the testing. This test shall be conducted by the final test and acceptance plan as outlined below.

3.4 FINAL TESTING AND ACCEPTANCE

- A. Prior to any final acceptance testing, the Contractor shall submit two sets of preliminary (draft) Record Documents to the Owner. The preliminary Record Documents are to be used by the Owner to conduct the system final test.
- B. Conduct a complete test of the entire final field installation of the Security System and provide the Owner with a written report on the results of that test.
- C. The Contractor shall submit documentation indicating completion of the testing to Owner before conducting System Acceptance testing. All items are required to be complete before a final inspection of the security system. If for some reason the Contractor is unable to fully comply with any of the listed conditions, a written statement describing the exception is to be submitted with the checklist for review. The checklist shall accompany the written certification to the Owner that the installed complete Security System has been calibrated, tested, and is fully functional as specified herein.
- D. After completion of Initial Acceptance testing the Owner shall conduct a fifteen -day (15) burn-in test. The intent of the burn-in test shall be to prove the Security System by placing it in real operating conditions. During this period, the Security System shall be fully functional and programmed such that all points, interfaces, controls, reports, messages, prompts, etc. can be exercised and validated. Record and correct any system anomaly, deficiency, or failure noted during this period. The failure of any component during the burn-in test shall cause the testing period to begin again and run again in its entirety until successfully completed. The issuing of the Final Acceptance Certificate is based on the successful completion of the burn-in testing.

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3.5 OPERATION AND MAINTENANCE MANUALS

- A. Intent: The intent of this section is to require complete documentation of the Access Control System for the purpose of system operation and maintenance during and after the warranty period. It is intended that the operation and maintenance manuals be exhaustive in the coverage of the system to the extent they may be used as the sole guide to the trouble shooting, identification, and repair of defective parts.
- B. Scope: The Contractor shall provide the Owner with six complete drawing books and maintenance and operation manuals on the completed system. These manuals shall include basic wiring diagrams, schematics, and functional details such that any component, wire, or piece of equipment in the system may be easily identified by going to the actual equipment and making reference to this manual. It is required that everything in the system be neatly labeled and easily identifiable. Every terminal, wire, component, or piece of equipment, relay, and other such items shall have a number or letter designation. All of these identification characteristics shall be included in the maintenance and operation manuals.
- C. Maintenance Manuals, Manufacturer's Literature:
 - 1. General: The maintenance manual requirement of this section is in addition to shop drawing requirements. Maintenance manuals and drawing sets shall be compiled after system fabrication and testing and shall incorporate any changes made after shop drawing submittal. The maintenance manuals and drawing books shall be permanently bound in hard plastic covers.
 - 2. Maintenance Manuals, Manufacturer's Literature: Provide manufacturer's standard literature, covering all equipment included in the system. The maintenance manuals shall contain specifications, adjustment procedures, circuit schematics, component location diagrams, and replacement parts identification. All references to equipment not supplied on this project shall be crossed out.
- D. Drawing Books: All drawings developed specifically for this project shall be reduced to 11" X 17", folded and bound with hard plastic covers. Provide component identification and cross reference on the drawings for the maintenance department to understand the function of each item (the block diagram), find the room where the device is mounted (contract document plans), find its location in a rack (arrangement drawings), find how it is wired (wiring diagrams), and its detailed specifications (vendor data sheets), and how to repair it (spare part lists). Include the following drawings as a minimum:
 - 1. Functional Block Diagram: Provide an overall block diagrams showing the major interconnections between subsystems.
 - 2. Arrangement Drawings: Provide drawings showing the physical arrangement of all major system components.
 - 3. Elevation drawings of all equipment racks showing the location of each component in the racks. Components in the racks shall be identified as in the functional block diagrams.
 - 4. Wiring Diagrams: Provide wiring diagrams showing all field-installed inter-connecting wiring. Wire identification on the diagrams shall agree with the wire markers installed on the equipment.

3.6 ACCEPTANCE

- A. Acceptance will be withheld until the successful completion of the following:
 - 1. Acceptance of all submittal.
 - 2. Delivery of final documentation.
 - 3. Successful testing.
 - 4. Successful demonstration, training and documentation review.

END OF SECTION 28 13 00

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SECTION 28 23 10 – VIDEO SURVEILLANCE CAMERAS

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.
- B. Provide work specified but not shown on Drawings, and work shown on Drawings but not specified, as though expressly required by both.

1.2 SUMMARY

- A. This Section includes all labor and materials including, but not limited to: Video Surveillance System Cameras (VSS) cameras, lenses, housings, mounting hardware and power supplies, required to form a fully functional network-based recording and surveillance system. The contractor shall install cameras at locations shown on the drawings including, raceway, providing all cables, voltage surge protection and mounting brackets as required.
- B. Transportation of digital (IP) signals for viewing and recording shall be via the network provided by Owner. Coordinate IP addressing, Ethernet switch- port assignments and bandwidth utilization as a part of the network implementation. Include all costs for this coordination in the cost of this proposal.
- C. The programming, testing, owner training and documentation of the installed cameras as shown on the drawings and specified herein are part of this project. All costs associated with programming, testing, training and documentation of the cameras shall be included in the proposal.
- D. The cameras provided by this section are required to be fully compatible with and integrated into the existing Avigilon Video Management System
- E. Provide all cameras, storage drive, servers, licenses and required accessories, such as mounting hardware, enclosures, power supplies, and voltage surge protection as required to provide the Owner with a fully functional, robust, and maintainable video imaging system as shown on the drawings and described in these specifications.
- F. Drawings are diagrammatic by nature. Contractor is required to coordinate exact mounting locations of new cameras with the Owner. Adjust camera placement and lenses to comply with the field of view shown on the schedules. Coordination with the Owner for approval of final camera views is required.
- G. TSA utilizes the Punta Gorda Airport Avigilon VMS system.

1.3 REFERENCES

- A. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.
- B. Conflicts
 - 1. Between referenced requirements: Comply with the one establishing the more stringent requirements.
 - 2. Between referenced requirements and contract documents: Comply with the one establishing the more stringent requirements.

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- C. The Video Surveillance Cameras shall be installed in accordance with the most current version of the following:
 - 1. "Recommended Security Guidelines for Airport Planning, Design & Construction" – Transportation Security Administration
 - 2. Building Industry Consulting Services International (BICSI): "Electronic Safety and Security Design Reference Manual (ESSDRM)" and "Telecommunications Distribution Methods Manual" (TDMM)
 - 3. American Society Industrial Security (ASIS) Protection of Assets Manual
 - 4. All National, Local and Owner codes, rules and regulations related to the installation of video surveillance cameras.
 - 5. Manufacturer recommended installation guidelines.

1.4 PRODUCT STANDARDS

- A. Provide at the time of installation the latest Commercial-Off-The-Shelf (COTS) version of all equipment. One-of-a-kind products are prohibited. Discontinued or prototype equipment shall not be acceptable. The features described in this specification shall be part of a standard product offering of features which shall only require configuration to enable the functionality described herein.
- B. Provide equipment suitable for the purpose for which it was manufactured. Field modifications made to adapt equipment for purposes other than what it was manufactured shall not be permitted.
- C. Provide equipment compatible with existing Avigilon VMS.

1.5 DELIVERY STORAGE AND HANDLING

- A. Equipment shall be delivered to the job site in original packages with labels intact and identification clearly marked. The equipment shall be made available to inventory by the Airport when delivered to the site. Equipment and components shall be protected from the weather, humidity, temperature variations, dirt, dust, or other containments at all times. Equipment damaged by the contractor prior to final acceptance shall be replaced at no cost to the Owner.

1.6 WARRANTY

- A. Provide a one (1) year warranty on the Work and all equipment and wiring provided as new under this contract. If, within one (1) year after the date of Final Acceptance of the Work or by the terms of any applicable special warranty provided by the manufacturer, any of the Work or equipment is found to be defective or not in accordance with the Contract Documents, the Contractor shall correct it promptly including all parts and labor after receipt of notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such defective conditions.
- B. Warranty Service: In the event that defects in the materials and/or workmanship are identified during the Warranty period, the Contractor shall provide all labor, travel expenses and materials as may be required for prompt correction of the defect at no additional charge to the Owner.
- C. During the Warranty period, the Contractor shall, upon receipt of a request for service from the Owner, deploy service personnel to the Owner's premises and complete corrective action within twenty-four (24) hours of arriving on site.
- D. Repair or replacement service during the warranty period shall be performed in accordance with the following schedule:
 - 1. Seven (7) days, twenty-four (24) hour, three (3) hour on-site response time shall apply for major system failure. A major system failure is defined as a failure that causes critical portions of a system to be unable to perform the task for which it was intended or creates a potential for an immediate security breach.
 - 2. Next business day response time shall apply for minor component and device failures not defined by the Owner as a major failure.

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3. The Owner shall be the sole authority to define a failure as a major or minor system failure.
- E. If the Contractor is unable to restore system operation during the warranty period within two (2) days of initially arriving on-site, the Owner reserves the right to require the Contractor to provide on-site manufacturer's service technicians at no additional cost.
- F. The Contractor's Warranty obligation shall include providing an Extended Support Agreement for the entire warranty period. The extended support agreement shall keep all cameras provided under this contract up-to-date by supplying the latest supported version of firmware patches.
- G. Immediately following the completion of a Warranty repair or service call, the Contractor's service personnel shall submit a written report to the Owner which details the service work performed, the cause of the trouble, and any outstanding work which is required to restore complete and normal operation.
- H. As part of the warranty, the Contractor shall perform preventative maintenance as required by the manufacturer to keep the warranty in force during the warranty period. The Contractor shall submit a list of manufacturer required items to be included in the preventative maintenance program. The list shall include maintenance to each item, the frequency of such maintenance, and the amount of time to be spent on each item for maintenance. At a minimum all cameras will be cleaned, inspected and presets adjusted every three (3) months, power supplies inspected and adjusted every six (6) months. On the one year anniversary of final acceptance every camera will be inspected and adjusted to meet the performance characteristics present at final acceptance. All first year maintenance shall commence starting with the date of final acceptance for the system.
- I. The Owner reserves the right to expand or add/delete to the system during the warranty period using their technicians or manufacturer authorized firm(s) other than the Contractor for such expansion without affecting the Contractor's responsibilities on the components originally provided by them under this project.

1.7 QUALITY ASSURANCE

- A. Contractor must be certified at the highest level by the manufacturer of the equipment being proposed by the Contractor.
- B. Contractor must have all of the necessary licenses to install security equipment required by authorities having jurisdiction.

1.8 ACTION SUBMITTALS

- A. General: Partial submittals are not acceptable. Submit all documentation in accordance with Section 013300 Submittal Procedures as well as this section. Where there is a conflict the more stringent will apply. The contractor shall not purchase/install any equipment or software until the Engineer has reviewed and accepted Product Data submittals.
- B. Product Data shall include the following:
 1. Submit manufacturer's data on System components including, but not limited to, electrical specifications, mechanical specifications, rough-in diagrams, and instructions for installation, operation, and maintenance.
 2. Equipment schedules listing all system components, the manufacturer, model number and the quantity of each along with a general functional description for each system component.
 3. A complete list of cable and wiring types and sizes, as well as the manufacturer and model number for each.
- C. Shop Drawings Submittal shall include the following.
 1. Floor plan drawings indicating individual device locations with device legends indicating manufacturers and model numbers for each device.
 2. System riser diagram showing all devices, wire runs and wire designations.

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3. Schematic block diagrams for each system showing typical equipment interconnection and basic component functionality, etc.
 4. Wiring diagrams for each subsystem defining the interconnection of all inputs and outputs for all equipment.
 5. Dimensioned floor plan and elevations of equipment racks, control panels, wiring closets and consoles.
- D. No portion of the Work shall commence, nor shall any equipment be procured until the Engineer has approved the Pre-fabrication Submittals in writing. All Work shall be in accordance with the manufacturer's installation instructions.

1.9 CLOSEOUT SUBMITTALS

A. Record Drawings

1. Record Documentation shall consist of "As-Built" Drawings produced from the hand marked field documents and Operation and Maintenance Manuals. The Record Documentation shall be submitted to the Engineer within forty-five (45) days after final acceptance.
2. Produce all Record Drawings using the latest version of AutoCAD. Record Drawings shall, at a minimum, include the following:
 - a. Floor plan drawings indicating device locations, with device legends indicating manufacturers and model numbers for each device.
 - b. Floor plan drawings indicating wire routing. Wire routing shall be delineated in straight line runs and be tagged with cable identification and terminal strip numbers to coincide with the installation.
 - c. Mounting details for all equipment and hardware.
 - d. Functional block diagrams for each subsystem.
 - e. Wiring details showing rack elevations, equipment wiring and terminations, and inter-rack wiring.
 - f. Typical point-to-point wiring diagrams for each piece of equipment and groups of equipment within the system.
 - g. Layout details for each riser location, including patch, power supplies, junction boxes, conduit, and any other security related equipment

B. Operation and Maintenance Manuals

1. The maintenance manual requirement of this Section is in addition to Shop Drawing requirements. Maintenance manuals and drawing sets shall be compiled after system fabrication and testing and shall incorporate any changes made after Shop Drawing submittal. The maintenance manuals and drawing books shall be permanently bound in hard plastic covers.
2. Maintenance Manuals, Manufacturer's Literature: Provide manufacturer's standard literature, covering all equipment included in the system. The maintenance manuals shall contain Specifications, adjustment procedures, circuit schematics, component location diagrams, and replacement parts identification. All references to equipment not supplied on this Project shall be crossed out.
3. Operation and Maintenance Manuals shall apply to all security related devices, equipment and software modules.
4. Power-up and power-down procedures for each subsystem.
5. Description of all diagnostic procedures.
6. A list of manufacturers, their local representatives and subcontractors that have performed Work on the Project. The list shall include contact names, phone numbers and addresses for each.
7. Installation and service manuals for each piece of equipment.
8. Maintenance schedules for all installed components. Schedules shall include inspections and preventative maintenance schedules, and documentation of all repaired or replaced equipment.

C. Testing and Acceptance Plans:

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1. Prepare and submit Test Plans, Test Procedures and Test Reports according to this Section. The tests shall clearly demonstrate the system meets the requirements of this Specification.

1.10 INTELLECTUAL PROPERTY

- A. Patents: Should patented articles, methods, materials apparatus, etc., be used in this work, the Contractor shall acquire the right to use patented materials. The Contractor shall hold the Owner and its agents harmless for any delay, action, suit, or cost growing out of the patent rights for any device on this project.
- B. Copyrights: Should copyrighted software be used in this work, the Contractor shall acquire the right to use copyrighted software. The Contractor shall hold the Owner and its agents harmless for any delay, action, suit, or cost growing out the copyrights for any software on this project.
- C. License to use: All software required for the complete operation of the system as specified herein shall be delivered with full ownership transferred to the Airport with a non-time-limited license to use on each machine it is installed on, including the right to make back-up copies.

1.11 RADIO/TELEVISION INTERFERENCE

- A. Expected RF Environment: This security system shall be installed in an airport and will be subject to background RF levels which are expected in such an area. It is the Contractor's responsibility to protect the system specified here from interference to and by other systems.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Camera manufacturer offered drivers provided to the VMS shall provide full control of the camera functions (including PTZ) from within the VMS. The use of generic ONVIF drivers that only provide only a video stream without PTZ control will not be considered as compliant. Cameras provided under this section must be registered in the published compatibility listing of the VMS manufacturer providing the system described in section 28 23 00 of this project.
- B. Unless otherwise noted on the drawings all cameras will utilize PoE+ power directly from the network switch. External power supplies or high-power mid-span injectors shall be provided by the contractor only when required by the camera manufacturer for proper operation of the cameras or to maintain proper operation in exterior environmental conditions. Power supplies or mid-span injectors shall be centrally located in the communications room where the Ethernet connections for the camera are terminated and be connected to a UPS or generator backed primary power source.

2.2 VIDEO CAMERAS AND EQUIPMENT

- A. For the camera types listed below, provide the proper model variant for indoor or outdoor use. Provide proper model variant for mounting these camera types per the camera schedule.
- B. Type 1 – 180 Degree Multi-Imager Camera
 1. Video Resolution 15MP (3x5MP)
 2. Horizontal Field of View: 180°
 3. Sensor Format: 1/ 2.8”
 4. Minimum Illumination: Color - 0.05 Lux Monochrome – 0.0
 5. IR Illumination: High Power 850nm LED; 98 feet max distance
 6. Full Field of View Resolution (stitched) 7776 x 1944
 7. Field of View Resolution per Sensor: 2592 x 1944

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8. Wide Dynamic Range: 100dB
 9. Frame Rate: Max Resolution – 15fps
 10. Lens: 4mm, auto-iris, remote focus
 11. Impact Resistance: IK-10
 12. Environmental Rating: IP66
 13. Compression H.265 , MJPEG
 14. ONVIF Profile: S and T Compliance
 15. Security: HTTPS, WS Authentication, 802.1x port-based authentication
 16. Network Protocols: IPv4, IPv6, HTTP, SOAP, DNS, NTP, RTSP, RTCP, RTP, TCP, UDP, IGMP, ICMP, DHCP, ARP.
 17. On Board Storage: Provide micro SDHC Class 10/UHS 32GB card installed in camera slot.
 18. Acceptable Manufacture
 - a. Avigilon 15C-H4A-3MH-180
 - b. Engineer approved equal
- C. Type 2 – 2MP Fixed Camera
1. Video Resolution 3840 x 2160
 2. Imager 1/ 2.8” CMOS
 3. Frame Rate 20fps at maximum resolution
 4. Min Illumination (color) 0.29 lux
 5. Min Illumination (B/W) 0.058 lux
 6. Video Compression H.264, M-JPEG
 7. Dynamic Range 100 dB Minimum
 8. Lens Type Varifocal 3.1mm – 8.4mm p-iris, remote zoom and focus
 9. Form Factor Mini-dome, IK-10
 10. SDHC Card Slot: Provide 32GB card
 11. Network Protocols: IPv4, IPv6, HTTP, SOAP, DNS, NTP, RTSP, RTCP, RTP, TCP, UDP, IGMP, ICMP, DHCP, ARP
 12. Security: HTTPS, WS Authentication, 802.1x port-based authentication, SNMP v3
 13. ONVIF: Profile S compliant
 14. PoE: 802.3af, Class 3
 15. Acceptable Manufacture
 - i. Avigilon H5SL
 - ii. Engineer approved equal
- D. Type 4 – Multi-imager 20MP Omni-Directional Camera
1. Video Resolution: 20MP (4 x 5MP)
 2. Sensor Size: 1 / 2.8”
 3. Frame Rate: 10 fps
 4. Full FOV Resolution: 10368 x 1944
 5. Min Illumination (color) 0.025 Lux
 6. Min Illumination (B/W) 0.005 Lux
 7. Lens: 2.8mm F1.2-103°
 8. Video Compression H.264, H.265, and MJPEG
 9. Wide Dynamic Range 100 dB
 10. 15/14 fps at maximum resolution
 11. PoE+: 802.3af, Class 3
 12. Streaming Video Eight (8) non-identical streams (2 per sensor)
 13. Network Protocols: HTTP, IPv4, 802.1x, RTSP, RTP/TCP, RTP/UDP, TFTP, DHCP
 14. Acceptable manufacture
 - a. Avigilon 20C-H4A-4MH-360
 - b. Engineer approved equal

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- E. Exterior Camera Surge Protection
 - 1. Protect all exterior video, data, control, power, signal cables and conductors against power surges. Provide protection against spikes, surges, noise, and other line problems for all system equipment and components.
 - 2. Surge protectors shall not attenuate or reduce data, video or sync signals under normal conditions. Each surge protector shall be UL Listed.
 - 3. Acceptable Manufacturers:
 - a. DITEK
 - b. Engineer approved equal
- F. Power Supplies
 - 1. Cameras are intended to be powered using Power-Over-Ethernet, however some camera housings and auxiliary devices that cannot be powered in such a manner will require an external power supply. These specifications apply for such products:
 - a. UL Listed low-voltage power supplies matched for voltage and current requirements of cameras or accessories.
 - b. When several devices requiring external power are associated with a single communications room location they shall be powered from the same multi-output supply, each output shall be electrically isolated from the other outputs.
 - c. Each output shall be individually protected from over current loads.
 - d. Provide multi-output power supplies with a minimum of (2) two spare outputs and a minimum of twenty-five percent (25%) excess current capacity unused by the planned attached load.
 - e. Rack or wall mountable. Contractor shall survey each location requiring a power supply and select the proper mounting type.
- G. Cables
 - 1. Comply with requirements in Section 271513 "Communications Copper Horizontal Cabling."
 - 2. Cables installed in an outdoor or exterior environment shall be outside plant (OSP) rated.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Contractor shall confirm camera views as noted on Camera Schedule with Owner prior to Final Acceptance. Field of view for all cameras shall be adjusted (manually and/or electronically) to achieve Owner's desired field of view.
- B. Install cameras and accessories level and plumb. Limit sources of vibration to provide a stable camera image.
- C. Install cameras with required minimum clear space below cameras and their mountings. Change type of mounting to achieve required clearance.
- D. Install power supplies and other auxiliary components in communications rooms unless otherwise indicated.
- E. It is required that everything in the system be neatly labeled and easily identifiable. Every terminal, wire, component, or piece of equipment, relay, and other such items shall have a number or letter designation. All of these identification characteristics shall be included in the maintenance and operation manuals."

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3.2 INSTALLATION OF CONDUCTORS

- A. General: Installation of conductors is specified in Division 26 and Division 27.
- B. Wiring within Enclosures and Racks/Cabinets: Bundle, lace, and train conductors to termination points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 IDENTIFICATION

- A. Label cables, equipment, panels, enclosures, modules, and power supplies with permanent markings to indicate system zone, partition, and circuit, and coordinate labels with record documentation. Contractor shall coordinate all labeling schemes and requirements with Owner prior to beginning construction.
 - 1. Label wires and cables as follows:
 - a. Mark all wire and cable in common at both ends.
 - b. Place wire identification numbers 12 inches from the ends of each cable by using sleeve type, heat shrinkable markers.
 - c. Install markers to be readable from left to right or top to bottom. Locate labels near termination points.
 - d. Install labels when wire and cables are installed.
 - e. Labeling shall agree with record documentation.
- B. Cable Labeling Scheme
 - 1. The labeling scheme shall identify the type of cable (VMS), the Communication room where the cable terminates, and a unique cable number.
 - 2. The labeling scheme shall not utilize room names and/or numbers as designations.

3.4 CONSTRUCTION PHASING

- A. A Preliminary Construction Phasing Schedule has been prepared with a general sequence of work phases and can be found in the drawings. Contractor shall be responsible in developing a detailed construction phasing schedule that will identify all phases of work including existing camera outages and duration of outages.

3.5 CYBER SECURITY REQUIREMENTS

- A. The Contractor must obtain a copy of the system manufacturer's cyber security hardening guide and implement the recommendations on all products installed as a part of this project.
- B. The Contractor must comply with the requirements of ISO 27001/27002 for all products installed on this project
- C. The Contractor must comply with the Owner's established cyber security policies for all products installed on this project

3.6 COORDINATION WITH OWNER'S IT DEPARTMENT

- A. Transportation of data for the PACS shall be via the Owner's existing local area network. Coordinate IP addressing, Ethernet switch port assignments, fiber optic cable use and bandwidth utilization with the Owner as a part of the network implementation. Include all costs for this coordination in the cost of this proposal.
- B. Provide required Category 6 and fiber optic patch cords as required to Owner's IT LAN network switch.

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3.7 TRAINING

- A. The Contractor must provide the Owner's staff with training to certify them to the same manufacturer's certification level as the Contractor.
 - 1. Training must be provided for IT staff to the level necessary to administer and configure the system.
 - 2. Training must be provided for maintenance technicians to allow them to service the system.
 - 3. Training must be provided operators monitoring the system.
- B. Training will need to be arranged to support staff members on their various shifts including those working after normal business hours.
- C. Training must be conducted on-site using the equipment provided by this project prior to substantial completion.
- D. Coordination with the Owner on the training schedule and subjects to be covered is required.
- E. This training must not relieve the Contractor of any obligations to repair the system under the warranty when notified by the Owner that a malfunction has occurred and requires their service.
- F. The Contractor must provide up to an additional twelve (12) hours of on-site re-training time during the warranty period should the Owner's staff request a refresher course during the warranty period.

3.8 TESTING

- A. All of the Contractor's Work shall be tested and inspected by the Owner's Representative including the Engineer. The Contractor shall coordinate and cooperate fully and shall provide at no additional cost to the Owner, manpower, blueprints, radios, facilities, motorized lifts, scaffolds, etc. to reasonably assist the inspectors.
- B. Testing shall occur in two phases. The first phase will be a functional and physical inspection of the installation. All faults found in this first phase will be corrected prior to the advancement to the second phase.
 - 1. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.
- C. The second phase of testing shall be a reliability test. The installed cameras shall operate for a period of not less than thirty (30) days without a malfunction. If a malfunction is identified during this period it shall be promptly corrected and the reliability test period start over again and run for another thirty (30) days unless restarted again by another malfunction. The camera will pass the second stage of testing when it is able to complete thirty (30) days of continuous operation without a malfunction. The Final Acceptance Certificate will only be issued after successful completion of the second phase of testing.
 - 1. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Conduct tests at varying lighting levels, including day and night scenes as applicable. Prepare video-surveillance equipment for acceptance and operational testing as follows:
 - a. Prepare equipment list indicating camera name/number and disposition at a minimum.
 - b. Verify operation of auto-iris lenses.
 - c. Set and name all preset positions; consult Owner's personnel.
 - d. Set sensitivity of motion detection.
 - e. Connect and verify responses to alarms.
 - f. Verify operation of control-station equipment.
- D. Contractor shall prepare test and inspection reports as part of the record documents

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- E. Video surveillance system will be considered defective if it does not pass all tests and inspections.

3.9 CLEANING

- A. Clean installed items using methods and materials recommended in writing by manufacturer.
- B. Clean video-surveillance-system components, including camera-housing windows, lenses, and monitor screens.

3.10 ACCEPTANCE

- A. Acceptance will be withheld until the successful completion of the following:
 - 1. Acceptance of all submittals.
 - 2. Delivery of final close-out documentation.
 - 3. Successful testing.
 - 4. Successful demonstration, training and documentation review.

END OF SECTION 28 23 10

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SECTION 28 31 11 – ADDRESSABLE FIRE ALARM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. General: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 SECTION INCLUDES

- A. This specification provides the requirements for the installation, programming and configuration of a complete Addressable Intelligent Fire Alarm System Network. The system shall include, but not limited to: Automatic and Manually activated alarm Initiating and Indicating Peripheral Devices and Appliances, conduit, wire and accessories required to furnish a complete and operational Fire Alarm System.

1.3 REFERENCES

- A. The equipment and installation shall comply with the current provisions of the following standards:
 - 1. National Electric Code, Article 760.
 - 2. National Fire Protection Association Standards:
 - a. NFPA72 National Fire Alarm Code
 - b. NFPA101 Life Safety Code
 - 3. Local and State Building Codes.
 - 4. Local Authorities Having Jurisdiction.
 - 5. ULC, CSFM, BSA
 - 6. Underwriters Laboratories Inc.
 - 7. The system and all components shall be listed by Underwriters Laboratories Inc. for use in fire protective signaling system under the following standards as applicable:
 - a. UL 864/UOJZ, APOU Control Units for Fire Protective Signaling Systems.
 - b. UL 268 Smoke Detectors for Fire Protective Signaling Systems.
 - c. UL 268A Smoke Detectors for Duct Applications.
 - d. UL 217 Smoke Detectors Single Station.
 - e. UL 521 Heat Detectors for Fire Protective Signaling Systems.
 - f. UL 228 Door Holders for Fire Protective Signaling Systems.
 - g. UL 464 Audible Signaling Appliances.
 - h. UL 1638 Visual Signaling Appliances.
 - i. UL 38 Manually Activated Signaling Boxes.
 - j. UL 346 Water flow Indicators for Fire Protective Signaling Systems.
 - k. UL 1971 Standard for Signaling Devices for the Hearing Impaired
 - l. UL 1481 Power Supplies for Fire Protective Signaling Systems.
 - m. UL 1711 Amplifiers for Fire Protective Signaling Systems.
 - 8. Americans with Disabilities Act (ADA) and State Equivalents.

1.4 SYSTEM DESCRIPTION

- A. Fire alarm work is an extension of the existing Johnson Controls multiplex systems and shall be performed by Johnson Controls. The system shall incorporate signal modules, addressable true alarm modules, and relay modules. Provide control outputs and monitor points for system function as described in this specification, and as shown on the drawings. The system shall utilize distributed processing techniques, be fully solid state (with exception to relays outputs for control function), be microcomputer based and use digital addressing techniques. All initiation devices shall be displayed on the new TrueSite Work Station (TSW) that replaces the existing Graphic Command Center (GCC) located in the landside communications center and engineering along with graphic displays showing floor plans with exact locations. The graphics

shall have rooms labeled and icons indicating type of device with address being displayed upon alarm. The system shall be an extension of the existing Johnson Controls Fire Alarm System. This system shall be fully usable as a "U. L." listed fire alarm, and conform to all state and local codes covering this project.

- B. All work and materials required to perform this section, whether shown on the drawings or not shall be included to provide a complete and working system. Contractor shall provide monitoring connections for individual annunciation to the fire alarm system for all fire protection valves.

1.5 SUBMITTALS

- A. Fire Alarm submittals shall be submitted according to the general guidelines of this specification, including the special provisions which follow:
 - 1. The title page for the fire alarm submittal shall contain:
 - a. The project name.
 - b. The project building name.
 - c. Submitting company name, address, and telephone number.
- B. Contractor shall submit full shop drawings indicating the following:
 - 1. Schematic diagrams for buildings, including equipment.
 - 2. Wiring diagrams, indicating connections between equipment.
 - 3. Conduit sizing.
 - 4. Description of operation.
 - 5. Control panel, interface/control of HVAC equipment, elevator, and smoke shutters.
 - 6. Manufacturer's catalog cut sheets indicating all devices to be used, inclusive of supplementary equipment and wiring.
 - 7. Normal and emergency battery calculations for all devices.
 - 8. Complete riser diagram for each system indicating wiring sequence of all alarm devices and control equipment.
 - 9. Technical resume of project supervisor, and factory trained technician performing services for the project.
 - 10. Full company resumes indicating years in business and a list of similar installation with telephone numbers and contacts at each location.
 - 11. Copies of professional license of contractor, any subcontractor, and the project supervisor.
 - 12. Manufacturer's qualifications indicating years in business, service policy, warranty definitions, and a list of installations similar to installations in the State of Florida.
 - 13. Proof that the submitting contractor is an authorized distributor of the product submitted, or written statements indicating the employment of services of an authorized distributor to perform work on the project.
 - 14. AutoCAD (registered) Rel. 14 compatible drawings of the building layout to be used to extend the existing color graphic interface. Upon award of the contract copies of the electronic systems drawings shall be made available on diskette, without cost, to the Contractor for development of these drawings.
- C. Submittal shall be complete with all items listed above. Partial submittals shall be returned to the contractor immediately upon receipt for resubmittal, and will not be reviewed. Drawings shall not be less than 8 1/2" x 11" in dimensions, and shall bear the project name, and represent all symbols used. AutoCAD Rel. 14 floor plans with fire alarm devices shown will be made available to the successful contractor at no cost.
- D. The control panel schematic, including build out of new modules selected, shall be submitted on a single diagram.
- E. The Contractor shall provide hourly Service Rates and Semi-Annual inspection prices, performed by a factory trained and authorized personnel, for this installation with the submittal. Proof of training and authorization of the servicing personnel shall be included in the submittal. The hourly service rates shall be guaranteed for a one-year period unless otherwise specified.

- F. Close-out Submittals: Two (2) copies of the following Manual shall be delivered to the Building Owner's representative at the time of system acceptance. The close out submittals shall include:
1. Operating manuals covering the installed Fire Alarm System.
 2. Point to Point diagrams of the entire Fire Alarm System as installed. This shall include all connected Smoke Detectors and addressable field modules. All drawings shall be provided in CAD and supplied in standard .dwg format. Vellum plots of each sheet shall also be provided. A system-generated point-to-point diagram is required to ensure accuracy.
 3. The application program listing for the system as installed at the time of acceptance by the building owner and/or Local AHJ (Disk and Hard copy printout).
 4. Name, address and telephone of the authorized factory representative.
 5. All drawings must reflect device address and programmed characteristics as verified in the presence of the engineer and/or the end user unless device addressing is electronically generated, and graphically printed.

1.6 QUALITY ASSURANCE

- A. The contractor shall visit the proposed site and familiarize themselves with local conditions, and the nature and extent of work. Contractor shall be fully aware of all aspects of the drawings and specifications prior to bid.
- B. Provide a factory-trained technician for supervisory use on the project during all control panel connections, adjustment testing, and system certification.
- C. All individual components of the system shall be manufactured and supplied by Johnson Controls. All control panels and devices shall bear the same manufacturer's name.
- D. The contractor performing this work shall be a Certified Alarm System Contractor I or Certified Unlimited Electrical Contractor, as described in Florida Statutes 489, Part II, and Florida Department of Professional Regulation.
- E. Warranty Acceptance: The Contractor must warranty service and make available to the Owner, a duly authorized and franchised distributor who shall service the fire alarm system and supply on-the-premise maintenance by factory trained service technicians during normal working hours.
- F. Warranty Period: The Contractor shall provide maintenance at no additional cost to the Owner for a period of 12 months from the date of substantial completion of the installation. Maintenance shall be for the standard use of the system and does not include damage caused by natural forces or physical abuse. The Contractor shall also agree that service, when provided at other than normal working hours, shall be made at a normal working hour's labor rate.
- G. A copy of the manufacturers' warranty shall be provided with closeout documentation and included with the operation and installation manuals.

1.7 SYSTEM STARTUP, OWNERS' INSTRUCTIONS, COMMISSIONING

- A. System startup shall be performed by Factory Trained personnel. Certain functions of the Systems Startup Procedure may be performed by a contractor under the direction of the Factory Trained and Authorized Engineered Systems Distributor.
- B. Owners' Instructions and Operation Manuals, specific for this project, shall be supplied to the Building Operations Staff by the Factory Trained and Authorized Engineered Systems Distributor. A "Generic" or "Typical" Owners' Instruction and Operation Manual shall not be acceptable to fulfill this requirement.
- C. Commissioning of the installed system shall be performed by the Factory Trained and Authorized Engineered Systems Distributor in the presence of the Local AHJ, the Building Owners' Representative, and a Representative of the General Contractor.

- D. A System Generated device map, which will serve as an “as-built” drawing shall be provided to the Local AHJ and the Building Owners’ Representative.

1.8 MAINTENANCE

- A. First Year Tests: The Contractor shall, at no expense to the Owner, observe the systems in operation and conduct tests to assure that systems are performing in full compliance with specified requirements at least twice during the initial 6 months of operation. The testing shall be coordinated with a designated Owners representative, at a time convenient to the Owner, with results reported in writing to the Owner.

1.9 SYSTEM OPERATION

- A. Upon activation of any fire alarm device in the building, the following sequence shall occur unless otherwise indicated:
 - 1. Immediately transmit the alarm condition to the Service Building Communications Center main control panel and initiate a positive alarm sequence for the system.
 - 2. Initiate positive alarm sequence in the Service Building Communications Center on the Johnson Controls Graphic Command Center and on the redundant Graphic Command Center in the service department.
 - 3. Display individual detector on alphanumeric display at the fire alarm control panel with user defined English language description, and transmit the condition to in the Service Building Communications Center on the new Johnson Controls TrueSite Work Station, replacing the existing Graphic Command Center) and on the redundant new TrueSite Work Station (Graphic Command Center) located in the service department.
 - 4. Light a local indicating lamp on area or duct detector initiating alarm.
 - 5. Provide contact closure interfaces to the building DDC or other control system.
 - 6. Activation of any duct smoke detector on an air-handling unit shall shutdown that air-handling unit only and immediately transmits the supervisory alarm condition to the Service Building Communications Center main control panel.
 - 7. Provide contact closure to the access control system (Security door) only when the general alarm is activated.
 - 8. Provide connection and alarm points for the DAS (Distributed Antenna System) - 5 fire alarm inputs per HCAA telecom room and in the radio room (not in the RAC telecom rooms) to monitor dry contacts coming from the life safety DAS systems to meet the code requirements of the installation of this system. The programming of those inputs shall be included in the scope and coordination with DAS vendor will be required to map each of the contact closures.
 - 9. Coordinate with fuel consultant documents for monitoring and connection points.
- B. Upon activation of the elevator machine room smoke detector, items A.1, A.2, A.6, of the above listed events shall occur in addition to:
 - 1. Activation of the Phase I or Phase II recall depending on the floor level at which the alarm was detected for the elevator bank only.
 - 2. Light the “Do Not Use Elevator” lamp at all levels.
- C. This system operation is to be followed for all subsequent alarms, signaling additional floors/areas, as they are needed. It shall be the contractor's responsibility to verify system operation with the A/E, Hillsborough County Aviation Authority (HCAA) and the Fire Marshal prior to system installation or programming.

PART 2 - PRODUCTS

2.1 GENERAL

- A. This Specification must be conformed to in its entirety to ensure that the installed and programmed System will accommodate all of the future requirements and operations required. Any specified item or operational feature not specifically addressed will be required to be met without exception.

2.2 EQUIPMENT AND MATERIAL GENERAL REQUIREMENTS

- A. All equipment furnished for this project 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 contract drawings and installation specifications shall be the best suited for the intended use and shall be provided by a single manufacturer. If any of the equipment provided under this Specification is provided by different manufacturers, then that equipment shall be recognized as compatible by both manufacturers, and "Listed" as such by Underwriters' Laboratories.
- B. System installation and operations shall be verified by the manufacturer's representative and a verification certificate presented upon completion. The manufacturer's representative shall be responsible for an on-site demonstration of the operation of the system and initial staff training as required by the Architect and/or Engineer.
- C. The system shall be capable of detecting the electrical location of each intelligent device including new and existing intelligent devices. It shall be possible to display the intelligent device map on a computer.

2.3 MANUFACTURERS

- A. Manufacturers: Firms shall be regularly engaged in manufacture of equipment types and service required, whose products have been in satisfactory use in similar service for not less than five years.
- B. Service Availability: The supplier shall have sufficient stock on hand and have a fully equipped service organization capable of guaranteeing response time within 8 hours of service calls, 24 hours a day, 7 days a week to service completed systems.
- C. The Engineered Systems Distributor of the Fire Alarm Equipment specified herein shall provide a copy of their certificate of successful completion of an authorized Training Course given by the Manufacturer of the Fire Alarm Equipment.
- D. Installer: The installing firm shall have at least three years of successful supplying and installation experience on projects with electrical installation work similar to that required for the project.
- E. Equipment design is based upon equipment manufactured by Johnson Controls. Due to the nature of the project, and the requirement for amendment to the existing Fire Alarm Service Agreement, no substitutions shall be permitted, without the authorization of the Hillsborough County Aviation Authority.

2.4 FIRE ALARM CONTROL PANEL (FACP)

- A. The FACP shall be configured as a microprocessor based unit capable of conducting system check outs, "walk testing," examine, scan, ground fault, power supply monitoring, system monitoring, circuit monitoring for each device, on initiating and indicating appliance circuits. Indicators shall be LED and a user definable 40 character alphanumeric display. User definable displays shall be English language descriptors indicating the type and location of device in alarm or trouble. Provide any additional material and software required. GCC screens shall be base on Airside A format.
- B. The FACP shall have a LCD display to match existing nodes and separate "Alarm" (Red), and "Trouble" (Amber) LED type indicators.
- C. The control panel shall continuously perform self-diagnostic testing on all processing electronics and devices installed in the field. Devices or sensors which have been determined as out of the operating window shall cause a "Self Test Abnormal" condition to be displayed at the control panel.
- D. The FACP shall monitor all interior circuits and modules for the removal or damage of system components. Removal or damage to interior modules shall result in a panel "Trouble" condition.

- E. Auxiliary control circuits such as Air Handling Unit (AHU) Shutdown, elevator recall, release of doors, etc... shall be accomplished from a supervised circuit with isolation relay. Auxiliary relays on sensor bases shall not be utilized for the switching of loads. All auxiliary circuits shall be normally de-energized.
- F. Control panels shall be configured with plug in modules, power supplies and any accessories required providing initiating and controlling function as required by this specification. Control panels shall be capable of supporting non-addressable devices via interface modules. Control panels shall contain all necessary components to completely service and operate the system. Signal circuits shall be provided as required to service signals shown. Provide integral side located wiring gutter and field wiring terminal strip. Provide blank panels for all empty spaces. Provide additional cabinets, power supplies, and other hardware/firmware/software for integrated operation of all control panels.
- G. Construction of all function modules shall be faceplate attached to edge- contact Printed Circuit Boards (PCB). All components shall be mounted as a module to printed circuit boards. Cabinet shall provide guide-way for PCB to internal wiring buss system. All PCB shall be glass epoxy high quality construction with smooth, bright soldering and completely free of solder paste residue. All face plate indicator shall be LED's. Each module shall be labeled. All LED's and switches shall be identified with silk screen type labeling. Furnish blank faceplates for all unused spaces.
- H. Provide IAM modules to interface between non-addressable initiating devices and FACP. Provide modules to accept data type-initiating circuits. Powered and non-powered alarm supervisory initiating devices and modules shall be Class B.
- I. Provide signal modules for style B signals wired in parallel. Provide for supervision of opens, shorts and earth grounds. All visual indicating circuits shall also be Class B.
- J. Provide supervised low voltage DC power supply modules to furnish filtered power for all system modules and system devices. Provide over-current devices for protection of system components. Provide status devices for normal power, power supply trouble and battery fuse trouble. The power supply modules shall supervise the loss of AC, loss of DC and low DC output. Should more power be needed than is available from one power supply, provide as many power supplies as required.
- K. The system shall provide output control circuits to control air handling equipment, fans, door release, smoke shutters, and elevator recall.
- L. Network communication:
 - 1. Network node communication shall be through a token ring configuration with fiber, furnished and installed by others.
 - 2. A single open, ground or short on the network communication loop shall not degrade network communications. Token shall be passed in opposite direction to maintain communications throughout all network nodes. At the same time the status of the communication link shall be reported.
 - 3. If a group of nodes becomes isolated from the rest of the network due to multiple fault conditions, that group shall automatically form a sub-network with all common interaction of monitoring and control remaining intact. The network shall be notified with the exact details of the lost communications.
 - 4. The communication method shall be NFPA 72 style 7.

2.5 TRANSPONDERS PANELS

- A. Distributed transponders are to be remotely located in various areas of the facility allowing peripheral devices to be connected at these locations instead of all circuits being routed back to the main FACP.
- B. Communications between transponders and the main FACP is via Style 7 (NFPA 72) Communications.

- C. Panels can provide for initiating device circuit cards, addressable interfaces for addressable devices, notification device circuits cards, LED/control switch modules auxiliary relay cards, power supplies, and amplifiers.

2.6 AUDIO VISUAL SIGNALS

- A. Equivalency: All strobe appliances or combination appliances with strobes shall be capable of providing the "Equivalent Facilitation" that is allowed under the Americans with Disabilities Act Accessibilities Guidelines (ADA (AG)), and shall be UL 1971, and ULC S526 Listed.
- B. Same Manufacturer: All appliances shall be of the same manufacturer as the Fire Alarm Control Panel specified to assure absolute compatibility between the appliances and the control panels, and to assure that the application of the appliances is done in accordance with the single manufacturer's instructions.
- C. Visual Alarms: The strobes shall have a red Lexan face plate. Addressable strobe shall be listed to UL 1971. The V/O shall consist of a xenon flash tube and associated lens/reflector system. The V/O enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot. V/O appliances shall be provided with different minimum flash intensities of 15cd, 75cd and 110cd. Provide a label inside the strobe lens to indicate the listed candela rating of the specific Visible/Only appliance.
- D. Audible Alarms: Provide electronic horns. Addressable horn shall be listed to UL 464. Horn shall support Temporal Code 3, March Time (20, 60, or 120 BPM), Continuous, and Temporal Code 4 coding patterns. Horn appliances shall have a High/Low Setting, programmable by channel from the addressable controller or by appliance from the host FACU. The horn shall have a minimum sound pressure level of 83 or 89 dBA for steady) or of 79 or 85 dBA for coded operation. The horn device shall consist of three pieces; appliance, cover and mounting plate. For ease of installation the mounting plate shall mount directly to a standard single gang, double gang or 4" square electrical box, without the use of special adapter or trim rings. When the appliance is connected to an active circuit, the front cover of the appliance shall be removable without causing a trouble indication on the fire alarm control unit. Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot.
- E. Audible Alarms: Provide speakers. Speaker notification appliances shall be listed to UL 1480. The speaker shall operate on a standard 25VRMS or 70.7VRMS NAC using twisted/shielded wire. The following taps are available: 0.25W, 0.50W, 1.0W and 2.0W. At the 1.0W tap, the speaker has minimum UL rated sound pressure level of 84dBA at 10 feet. The speaker shall have a frequency response of 400 to 4000 Hz for Fire Alarm and 125 to 12 kHz for general signaling
- F. Audio-Visual Alarm
 - 1. Provide horn/strobes as indicated on the drawings. The device shall have a red plastic housing and shall be selectable for high or low dBA output. Selection of low or high output shall be reversible. Horns shall be selectable for steady or temporal output. Addressable Notification Appliances are permitted.
 - 2. Provide speaker/strobes as indicated on the drawings. Speaker/Visible: Combination Speaker/Visible (S/V) units combine the speaker and visible functions into a common housing. The S/V shall be listed to UL 1971 and UL 1480. Addressable functionality controls visible operation, while the speaker operates on a 25VRMS or 70.7VRMS NAC.
 - a. Twisted/shielded wire is required for speaker connections on a standard 25VRMS or 70.7VRMS NAC and UTP conductors, having a minimum of 3 twists per foot is required for addressable strobe connections.
 - b. The following taps are available: 0.25W, 0.50W, 1.0W and 2.0W. At the 1.0W tap, the speaker has minimum UL rated sound pressure level of 84dBA at 10 feet.
 - c. The S/V shall have a frequency response of 400 to 4000 Hz for Fire Alarm and 125 to 12 kHz for general signaling.
 - d. The S/V installs directly to a 4" square, 1 1/2" deep electrical box with 1 1/2" extension.

2.7 ADDRESSABLE MANUAL STATIONS

- A. Manual fire alarm pull stations shall be single action, semi-flush, non-coded, normally open with two contacts. A downward pull of the lever shall activate a contact to initiate a pre-alarm. A key switch on the pull station shall activate a second contact that will initiate a general alarm. Keys for the general alarm switches shall match keys used in pull stations located in existing pull stations of the TIA facility.
- B. Station shall remain actuated until station is reset by means of a special key. This station-reset key shall match keys used for this purpose in existing pull stations of the TIA facility.

2.8 ADDRESSABLE PHOTOELECTRIC DETECTORS

- A. The detectors shall be of the addressable photoelectric type and shall utilize a light emitting diode (LED) and light sensing photodiode positioned within a sensing chamber. The LED shall emit light to the photodiode at all times. Upon entry of smoke or other materials, light from the LED shall be scattered about the sensing chamber causing the detector to enter a pre-alarm condition. The threshold sensitivity of detectors shall be maintained and adjustable from the control panel. All detectors shall be a two-wire device configured for Class B circuits. Alarm conditions shall be generated by the control panel upon comparing the stored value and sensor value of a particular device.
- B. Detector bases shall be individually addressable thereby allowing the removal of detectors and replacement without special programming to the detector.
- C. Each detector or detector base shall incorporate a steady state light to indicate if the device is in alarm and connections for use with remote lamps.
- D. Detector bases (or directly adjacent to base) shall be labeled with the assignment point configured in the system.
- E. All detectors shall be listed under UL 268.

2.9 ADDRESSABLE PHOTOELECTRIC DUCT DETECTORS

- A. The air duct mounted detectors shall operate on a cross sectional air sampling principle to overcome stratification and skin effect. The air duct detector shall consist of a photoelectric detector mounted in an air duct sampling assembly with sampling tubes that protrude across a minimum of 75% of the width of the duct for sizes 24" and below, and the entire width of the duct for sizes 24" and above. The air duct detector shall be installed in the duct as indicated in the manufacturer's instructions. The air sampling tubes shall conform to the dimensions of the air duct construction and shall be constructed of ½" EMT tubing. Sampling tubes that span the entire width of duct shall protrude through the side of the duct and finish with an escutcheon plate.
- B. The lamp in the detector and at the remote lamps shall light to indicate the initiation of the alarm. The detector base shall have terminals for making all connections; no soldering shall be required. If maintenance is required, the disassembled detector shall be capable of normal handling without causing damage to components such as field effect transistors. Detector, when duct mounted in non-metallic (fiberglass), shall be mounted on sheet metal collar installed in duct so that detector is firmly secured even after repeated removal. Detector housings shall be adequately gasketed to prevent air leakage from the duct or detector housing. Hinged access doors shall be provided as required to permit access to detectors above non-accessible ceilings or in chases. Door shall be labeled with an engraved laminate label reading: "Fire Alarm Duct Detector."
- C. Each detector or detector base shall incorporate a steady state light to indicate if the device is in alarm and connections for use with remote lamps.

- D. Detector bases shall be individually addressable thereby allowing the removal of detectors and replacement without special programming to the detector.
- E. Detector bases shall be labeled with the assignment point configured in the system. Labels shall be printed, background color to match base, and permanently affixed to the base or detector housing.
- F. Duct detectors shall have a supervised output for a fan shutdown relay and be programmable for activation upon any alarm. Contacts shall be rated at 10 Amps via remote relays as required.
- G. All detectors shall be listed under UL 268.

2.10 REMOTE TEST STATION

- A. A remote test station shall be provided for each duct or concealed detector to test smoke detector operation remotely. Test stations shall be located in readily accessible locations, labeled with the identification of the HVAC unit associated with the detector, and when the HVAC unit location is not obvious from the location of the test station, a permanently engraved sign shall be installed at the test station location, which graphically depicts access to the HVAC unit. The test station shall contain a lamp(s) to indicate alarm. Labeling shall be complete and indicate the AHU unit number, supply or return duct, and the addressable point assigned to the detector being monitored.

2.11 THERMAL DETECTORS: ANALOG TYPE

- A. Automatic heat detectors shall be analog type rated at 135 degrees fixed temperature and rate-of-rise type, ceiling-mounted, unless noted. Heat detector shall show unit in alarm. Provide point addressable auxiliary addressable modules with each detector that is not analog.
- B. Detector bases shall be labeled with the assigned point configured in the system. Labels shall be printed and permanently affixed.

2.12 NON ADDRESSABLE INTERFACE MODULE

- A. Modules shall be provided for all non-addressable system devices. These devices include but are not limited to:
 - 1. Water flow switches
 - 2. Tamper switches
 - 3. Thermal detectors
 - 4. Fire pump controller and low air for pre-action systems per NFPA
 - 5. Generator controller per NFPA

2.13 ADDRESSABLE SIGNAL MODULE WITH ISOLATION RELAY

- A. Modules shall be provided for interface and control of other systems in the facility. These include, but are not limited to: smoke shutter door operation, fire and exit door release in conjunction with the access control system, elevator recall services, fire sprinkler system valves, etc.

2.14 ANCILLARY DEVICES – GENERAL

- A. Ancillary devices submitted for use must have written proof of their compatibility for the purpose intended. Such proof shall be in the form of documentation from all manufacturers that clearly states that their equipment (as submitted) is 100% compatible with each other for the purposes intended.

2.15 REMOTE RELAYS

- A. Multi-Voltage Control Relays: Provide remote control relays connected to supervised ancillary circuits for control of fans, dampers, door releases, etc. Relay contact ratings shall be ORDPDT and rated for 10 amperes at 115 Vac. A single relay may be energized from a voltage source of 24 Vdc, 24 Vac, 115 Vac, or 230 Vac. A red LED shall indicate the relay is energized. A metal enclosure shall be provided.

2.16 ELECTROMAGNETIC DOORHOLDERS

- A. Wall Mounted, 2088-9585 Series: Provide semi-flush wall mounted electromagnetic door holder/releases rated at 24 Vac/dc. Finish shall be brushed zinc.

2.17 SMOKE DAMPER CONTROL

- A. Operation: Smoke Dampers or combination Smoke and Fire Dampers shall operate as specified herein, and as indicated in the Sequence of Events provided in Division 23 Specifications.
- B. Power: Power for electrically operated Smoke Dampers or combination Smoke and Fire Dampers shall be from the same power source as the Air Handling Unit or Exhaust Fan where the associated duct is controlled by that damper. Shut down of Air Handling Unit or Exhaust Fan for servicing shall cause associated dampers to close.

2.18 MICROPACK VISUAL FLAME DETECTION

GENERAL CAPABILITIES

The camera shall be a combined color surveillance system and flame detector. The camera shall employ video imaging based flame detection technology. Additionally, the flame camera shall operate on 24 volts D.C. and provide relay, video, RS 485 and/or 4-20mA outputs.

ENCLOSURE

All the sensing and signal processing elements shall be enclosed in a single seamless aluminum or stainless steel enclosure

INGRESS PROTECTION

IP66 / NEMA 4X

SELF-TEST CAPABILITIES

The camera shall have true optical testing capabilities. A failure in the optical test will be indicated by de-energizing the fault relay, dropping the analog current output to 2 milliamps and provide a signal via the RS 485 communications output

CROSS SENSITIVITY AND FALSE ALARM RESISTANCE

The flame detector must not suffer a decrease in sensitivity in the presence of hot surfaces, or respond to reflected flare radiation, arc welding or hot CO₂ emissions.

INSTALLATION AND MAINTENANCE

The camera shall have a modular design that will allow the electronics module to be easily field replaced without disturbing field wiring. All optical surfaces shall be easily accessible for cleaning.

No metal rods or reflectors shall be allowed in front of the sensor window.

Field wiring terminals shall be suitable to accept up to 16AWG cable.

INTELLIGENT DIGITAL SIGNAL PROCESSING

The signal processing circuitry shall require the flame radiation to exceed a minimum threshold level, before signaling a fire alarm condition.

Device shall have appropriate visual recognition software algorithms that can compensate for the combination of moving object reflective sources and “hot spots” such as encountered with train and tanker off-loading facilities.

DEVICE UPGRADEABILITY

Device firmware can be easily field upgraded to incorporate all of the latest DSP algorithms to minimize the possibility of false alarms.

FLAME SENSITIVITY

The camera shall be capable of responding to a 1 square foot n-heptane pan fire at 144 feet within 4 seconds and shall have a 90° cone of vision with no degradation in sensitivity at 45 degrees off axis.

DEVICE MEASUREMENT SIGNAL AND VIDEO OUTPUT CHARACTERISTICS

The outputs of the device shall be a normally de-energized Form C relay, a 4 -20mA signal or an RS 485 signal for the fire output.

The video output shall be capable of supporting coaxial or twisted pair cable.

DATA LOGGING

Actual alarm events shall be automatically recorded to an onboard micro SD card and the video files can be downloaded over the existing alarm wiring.

APPROVALS

The camera shall be hazardous area certified by FM, FMC and ATEX and be certified to IEC 61508 Part 1, 2 and 3 for SIL2 operation.

ENVIRONMENTAL CONDITIONS

The camera shall be rated for a continuous operating temperature range of -76 °F and +185 °F / -60 °C to +85 °C

Allowable range of humidity: 0 to 100% RH

The detector shall not be affected by water on the optics

PART 3 - EXECUTION

3.1 GENERAL

- A. The entire system shall be installed in a skillful manner in accordance with approved manufacturers' manuals and wiring diagrams. The contractor shall furnish all conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for the complete installation. All wiring shall be of the type recommended by the NEC, approved by local authorities having jurisdiction for the purpose, and shall be installed in dedicated conduit throughout.
- B. All penetration of floor slabs and fire walls shall be fire stopped in accordance with all local fire codes.

- C. End of Line Resistors shall be furnished as required for mounting as directed by the manufacturer.
- D. All wiring shall be installed according to NEC standards per the drawings submitted by the authorized Engineered Systems Distributor, unless otherwise noted.
- E. Installation: Provide all conduit, cable, equipment, accessories and materials as detailed in the manufacturers' installation manual and require for the satisfactory operation of the fire alarm system, the elevator detection system, mechanical systems control, and the interface between components and systems.
- F. Mounting Heights:
 - 1. Install manual pull stations 48" AFF to centerline of device.
 - 2. Wall mounted horns/speakers shall be located 80-inches (minimum) and 96-inches (maximum) above the finished floor measured to bottom of device.

3.2 CONDUITS:

- A. Related documents: the requirements of section 26 0533, Raceways and conduit shall apply to this work.
- B. Raceways shall be minimum ¾" EMT unless otherwise noted. All Fire Alarm system junction boxes and conduit shall be painted red. Raceway systems shall be complete to insure electrical continuity for grounding purposes. Ceiling mounted devices shall be served with minimum ½" flexible metallic tubing and connectors on both ends.
- C. Maximum allowable wire fill shall be 40%.
- D. Provide galvanized steel sleeves when conduits pass through walls/floors, sized for at least ¼" clearance. Maintain fire rated integrity of penetrations.

3.3 INSTALLATION OF DETECTORS:

- A. All ceiling mounted detectors shall be installed in accordance with requirements of NFPA 72.
- B. Detectors shall be positioned to avoid drafts from supply air diffusers and an adequate distance from equipment producing sudden temperature changes which would result in nuisance false alarms.
- C. Installation of duct mounted smoke detector housings and sampling tubes within the HVAC ductwork shall be by the Mechanical Contractor. It shall be the Fire Alarm Contractor's responsibility to provide the back-box and sampling tubes to the Mechanical Contractor for installation within the ductwork. All electrical connections shall be done by the Fire Alarm Contractor.

3.4 SPECIAL CONDITIONS:

- A. Contractor shall be responsible for all coordination required with the elevator vendor in order to provide wire/conduit to interface points in elevator equipment room for elevator recall and shutdown functions as required by NFPA and ANSI 4A sections on elevators. Test elevator recall operation (see inspection and testing form attached to this specification).

3.5 WIRING AND COLOR CODES:

- A. Fire alarm raceways shall be utilized only for the detection, alarming, or auxiliary functions associated with the Fire Alarm system. Wiring for other systems is strictly prohibited. Splices shall be located only in junction boxes containing a fire alarm device with approved connectors, or in terminal cabinets utilizing barrier strips and spade lugs. Fire alarm pipe couplings and boxes shall be painted red.
- B. Terminal cabinets shall be laid out, prior to wire pulling to determine the amount of terminal strips required and clear space between each strip. Conductors shall be neatly bundled upon entry to the cabinet, and

“fanned” out on an as needed basis. Conductors shall individually exit the main bundle directly adjacent to the lug at which they will be terminated.

- C. System wiring shall be as required for the system configuration. Special emphasis shall be placed on the use of conventional wiring in locations where required. Use as per manufacturer specification.
- D. All wiring shall test free from shorts, opens, grounds, or other faults.
- E. Wiring color code for the system circuits shall be as follows:

Alarm/Supervisory initiating	Red- Positive Black- Negative Twisted Shielded Yellow Jacket
Alarm Indicating Visible Indicating	Orange- Positive Brown- Negative
Control Circuits (AHU Control, Door Control) (Elevator Control, Ex. Fans) Other Circuits	Pink- Positive Gray- Negative- 24V Yellow- 120V Red & Black- (Remote Lamps, Etc...) Pink & Gray-(Distributed Control Power)
AC Power	Phase- Black, Red or Blue Neutral- White Grounding- Green

- F. Maximum allowable wire fill in conduit shall be 40%.
- G. Pull Strings to be provided in all empty conduits greater than 50’-0”.

3.6 DEVICE LABELING

- A. Label all initiating devices with their associated node number, channel number and address (device number).
- B. Label all indicating devices with their associated signal circuit number.

3.7 PRODUCT STORAGE AND HANDLING

- A. Protection: Physically protect smoke and heat detectors against damage as recommended by manufacturer. Minimize exposure of detectors to dirt and dust from construction. Provide plastic covers during construction. Remove covers after the project has been cleaned and is ready for operation. Testing must be done after the removal of protective covers.
- B. Packaging: Store equipment in original packaging. Store inside well ventilated area protected from weather, moisture, dust, extreme temperatures, and humidity.
- C. Damage: Remove and replace with new, all broken pull stations, detectors, annunciation devices and other accessories, damaged before final acceptance at no additional expense to the contract. No allowances shall be made for breakage or theft before final acceptance.

3.8 FIELD QUALITY CONTROL

- A. The system shall be installed and fully tested under the supervision of trained manufacturer's representative. The system shall be demonstrated to perform all the functions as specified.

3.9 ACCEPTABLE INSTALLERS

- A. The Fire Alarm System specified herein shall be installed by a Factory Trained and Authorized Engineered Systems Distributor.
- B. Field Connected Devices may be installed and wired, and primary power may be wired by licensed contractors under the direct supervision of a Factory Trained and Authorized Engineered Systems Distributor.

3.10 EXAMINATION

- A. Prior to the commencement of any of the work detailed herein, an examination and analysis of the area(s) where the Fire Alarm System and all associated components are to be installed shall be made.
- B. Any of these area(s) that are found to be outside the manufacturers' recommended environments for the particular specified products shall be noted on a Site Examination Report which shall be given to the Building Owners' Representative, and the local AHJ.
- C. Any shorts, opens, or grounds found on existing wiring shall be corrected prior to the connection of these wires to any panel component or field device.

3.11 DEMONSTRATION

- A. Each of the intended operations of the installed Fire Alarm / Life Safety System shall be demonstrated to the Building Owners' Representative and the Local Authority Having Jurisdiction by the Installing ESD.

3.12 INSTALLATION OF DUCT DETECTORS

- A. General: Installation of duct mounted smoke detector housings and sampling tubes within the supply and return air ductwork shall be done by an experienced sheet metal worker.
- B. Location: Detector shall be mounted at least 6 duct widths downstream, from any duct opening, deflection plates, sharp bends or branch connections. The Mechanical Contractor shall provide air pressure differential test data to engineer in areas where distance is limited by physical restraints.
- C. Assurance: Proper air velocities shall be maintained per the manufacturer's specifications, by the Mechanic Contractor as indicated in Division 23.
- D. Wiring: It shall be the Contractor's responsibility to provide the proper black box and sampling tubes for installation within the ductwork. All electrical connections shall be completed by the Fire Alarm Contractor as required for a complete system.

3.13 DOORS IN SMOKE WALLS

- A. Hold Open Devices: All doors in smoke walls shall be required to have magnetic door hold open devices. Doors normally kept closed or locked such as toilets, dressing rooms, closets, and mechanical/electrical rooms, do not require hold open devices.
- B. Type: Contractor shall review all doors in the smoke walls to determine the most appropriate type of door holder. Doors with no convenient adjacent wall require the installation of header type units.
- C. Identification: Doors in smoke walls not protected by magnetic hold open devices shall be brought to the attention of the Architect and be provided with a sign, mounted at normal viewing height with the following statement: "Fire Door – Keep Closed At All Times". The sign shall be of laminated plastic with 2 inches high, minimum, letters, red on white background. The sign shall be permanently secured to the door with brass screws, minimum #4.

- D. Smoke Detectors: Smoke detectors located at doors in smoke walls shall be located no further than 5 feet and no less than 1 foot from the door.

3.14 SPRINKLER SYSTEM

- A. Tamper Switch Supervisory System: Provide connections for sprinkler system tamper switches as required.
- B. Water flow Switch: Provide connections to water flow switches to the water flow zone as required.

3.15 ELEVATOR RECALL AND DETECTION SYSTEM

- A. Installation: Contractor shall provide all conduit wiring and associated devices and detectors for Phase I recall and emergency elevator power disconnection.

3.16 INSPECTIONS AND INSTALLATION TESTING

- A. Local Authority Having Jurisdiction: Equipment shall be installed and located in accordance with requirements of the local authority having jurisdiction.
- B. Demonstration: Upon completion and inspection by the Contractor, an authorized Owner representative shall physically inspect the installed equipment, workmanship, and witness Contractor performed acceptance tests to the fire alarm systems that demonstrate compliance to specifications.
- C. Personnel: The Contractor shall provide equipment and personnel, as required, for acceptance tests and any tests required by inspecting authorities.
- D. Deficiencies: The Contractor shall correct all system deficiencies and make all necessary adjustments at no cost to the Owner. Perform another acceptance test after correction of deficiencies.
- E. Notification: Before proceeding with any testing, inform the staff of the location where the alarm signal will sound to prevent any unnecessary action. At the conclusion of testing, those previously notified (and others necessary) shall be further notified that testing has been concluded.
- F. Hazardous Locations: Any method or device used for sensing in an atmosphere or process classified as hazardous by Article 500 of NFPA 70, National Electric Code, shall be listed, and suitable for such use.
- G. Reports: Records of all inspections and tests shall be made and submitted at the conclusion of work.

3.17 SMOKE DETECTOR SENSITIVITY TESTING

- A. Testing: Sensitivity settings shall be recorded for all heads and submitted to Engineer at completion.
- B. Reporting: Utilize "Detector Sensitivity Report" included at the end of these specifications for recording test results.
- C. Testing of Existing Equipment: Inspections and tests of existing equipment shall be performed to insure that all control functions, operating panels, annunciation devices and each detector is in reliable operating condition. This equipment shall be connected to the new system so all control functions; annunciation, etc. operate as one system.

3.18 HEAT DETECTOR TESTING

- A. Procedure: A restorable heat detector and the restorable element of a combination detector shall be tested as recommend by NFPA.

- B. Precaution: Precaution shall be taken to avoid damage to the non-restorable fixed temperature element of a combination rate-of-rise fixed temperature detector. The manufacturer's instructions and NFPA recommendations shall be followed.

3.19 SMOKE DETECTOR TESTING

- A. Response: To assure that each smoke detector is operative and produces the intended response, it shall be caused to initiate an alarm as its installed location with smoke or other aerosol, acceptable to the manufacturer that demonstrates that smoke can enter the chamber and initiate an alarm.
- B. Method: To assure that each smoke detector is within its listed and marked sensitivity range, it shall be tested using either one of the following:
 - 1. A calibrated test method.
 - 2. The manufacturer's calibrated sensitivity test instrument.
 - 3. Listed control equipment arranged for the purpose.
 - 4. Other calibrated sensitivity test method acceptable to the authority having jurisdiction.
- C. Range: Detectors found to have sensitivity outside the accepted range shall be replaced.
- D. Exception: Detectors listed as field adjustable may be either adjusted within an accepted range or replaced.
Note: The detector sensitivity cannot be tested or measured using any spray device that administers an unmeasured concentration of aerosol into the detector.

3.20 CLEANING

- A. Method: Clean all detectors and remove dust or dirt that has accumulated. For each detector, the cleaning, checking, operating, and sensitivity adjustment shall be attempted only after consulting the manufacturer's instructions. These instructions shall detail methods such as vacuuming to remove loose dust and insects and washing to remove heavy grease and grime deposits. In lieu of these cleaning methods, the manufacturer may provide cleaning service at the field location. Following partial disassembly or washing of the detector to remove contamination, the appropriate sensitivity test required shall be performed.

3.21 PERFORMANCE TESTING

- A. Prior to request for substantial completion inspection, the contractor certifying the installation shall perform all tests required under NFPA 72H, and the recommended test procedures outlined by the equipment manufacturer. All system detectors shall be cleaned, and adjusted for a maximum stable sensitivity setting. Performance verification and detector adjustments shall be made in the field with the devices operating. Bench testing and setting of detector sensitivity shall not be considered acceptable. A complete report shall be prepared and submitted, in triplicate, 7 working days prior to the time of inspection which shall include, but not be limited to the following:
 - 1. A complete list of equipment installed and wired.
 - 2. Indication that all equipment is properly installed and functions in conformance with these specifications.
 - 3. Test of individual zones/nodes and communication links.
 - 4. Sensitivity settings for each automatic detection device.
 - 5. Sensitivity and pressure differential testing at each AHU detector.
 - 6. Response times of all system fire protection flow switches.
 - 7. Any adjustments by sprinkler contractor.
 - 8. Loop resistance test for each circuit according to NFPA 72H.
 - 9. Isolation resistance testing between system conductors in a "conductor to conductor and "Conductor to ground" format as indicated in NFPA 72H.
 - 10. Test of zoned voice evacuation system to verify control, loudness, and intelligibility in all areas.
 - 11. Test of all HVAC, fan, smoke, shutter, door control, elevator recall, and other controls derived from the fire alarm system.
 - 12. Technician's name, certificate number and date.

3.22 SUBSTANTIAL COMPLETION TESTING

- A. Final system testing shall be conducted in the presence of the engineer, representative from the local authority, and the HCAA. All component/system identification/labeling shall be fully complete prior to substantial completion testing. Contractor shall supply all equipment and labor necessary to perform the testing procedures as described below. Any condition found that constitutes failure of the substantial completion inspection that is the result of improper documentation, system failure or fault, or other events deemed the Contractor's responsibility shall be grounds for financial compensation to the attending parties by the contractor. All costs associated with the re-test of the systems shall be borne by the Contractor.
- B. The tests, as described above, shall be directed by A/E, and will contain, but not be limited to the following items:
 - 1. Place all system detectors, and monitor modules in Alarm to verify the device address, and English language descriptions.
 - 2. Operate all control modules for alarm control. Verification of module address shall also be made.
 - 3. Reset all devices, and verify the normal condition of the panel, and display of any off-normal conditions which remain.
 - 4. Test all initiating devices for alarm verification. A device placed in alarm shall remain in that state until verified and then reset.
 - 5. Removal of a minimum of two devices per zone or data loop to verify the integrity of loop supervision.
 - 6. Removal of primary power to verify the transition circuitry from normal to emergency back up, and from emergency back up to battery set.

3.23 ENDURANCE TESTING

- A. Upon final acceptance, the system shall be entered into an endurance test, which will verify the stability of the devices installed in the system. The test shall be comprised of a ninety day period, commencing with the day of substantial completion acceptance. The test shall adequately demonstrate the stability of all devices and the absence of nuisance alarms. Upon an alarm event during this period, the Contractor shall document the device, time and date of the event, and submit to the architect/engineer for review complete with a concise explanation indicating the events which caused the device to alarm.
- B. Should the event be deemed unwarranted, the Contractor shall replace the device in question, and begin another ninety day endurance testing period.
- C. Should verification of the device in the field be required, the Contractor shall supply all materials and labor to test the device in question.

3.24 DOCUMENTATION

- A. Upon final acceptance, the Contractor shall submit the following information as part of document and project close out:
 - 1. Final reports as described under "PERFORMANCE TESTING".
 - 2. Detailed catalog cut sheets of all devices used in the system. Provide telephone numbers and addresses of factory repair services.
 - 3. Accurate reproducible drawings using AutoCAD (Registered) Release 14 or higher. Drawings to indicate accurate locations of all devices, raceways, junction boxes, wiring diagrams, and wiring nomenclature. Detail drawings of each terminal cabinet and labeling shall also be provided. All drawings shall be submitted on disks in addition to Mylar reproducible media.
 - 4. Back up documentation and a permanently affixed label at the fire alarm control panel indicating service record as described in rule 4A-48 by the office of the State Fire Marshal.
 - 5. Three (3) copies of composite "Operation and Maintenance" manuals in three ring binders, labeled "Fire Alarm System", complete with information regarding the facility, name or number,

contractor's name, number, and address, and submittal date. Manufacturer's data shall be provided for all devices used in the system. Pertinent items shall be separated by index tabs.

3.25 SYSTEM TRAINING

- A. The Contractor shall provide 4 hours of training on the system. Division of training hours shall be at the discretion of the HCAA. Contractor shall provide a fully-qualified technician who is familiar with the installed system, to perform training session.

3.26 WARRANTY

- A. Warranty shall include parts, material, labor, field service, and traveling times required to perform service. Response time shall be within 4 hours from the request for service, seven days a week.
- B. Warranty shall include one year testing as described in NFPA 72H including:
 - 1. Regular and systematic examination of all system devices, including interfaces to auxiliary systems.
 - 2. Regular and systematic examination and adjustment of system devices, following periodic cleaning, as required.
 - 3. Test and written report of all site visits and services performed on the system. Re-certification of the system shall be included.
 - 4. Test and written report of acceptance by the HCAA.

3.27 SYSTEM MAINTENANCE SERVICE

- A. Full Service Warranty Maintenance (Warranty): The Fire Alarm System Contractor (Johnson ControlsGrinnell) shall provide the Owner with prepaid full service warranty maintenance to include all labor, materials, parts, and equipment necessary to provide all required preventative and corrective maintenance for the fire alarm system. Warranty shall be for a period of one (1) year after the final acceptance of the work. At the end of the warranty, it shall be, at the Owner's option, renewable for an additional period at cost to the Owner under separate Contract. Warranty shall commence on the date of final formal acceptance by the owner. Services and obligations provided by the maintenance Contractor shall be as follows:
 - 1. Preventative Maintenance: Provide all required preventative and periodic maintenance operations as recommended by the manufacturer and at the intervals recommended by the manufacturer which shall include one complete recalibration of all installed devices on an annual basis until the end of warranty, or by internal software. Service shall also include remote software diagnostics support, software application support, software updates and revisions, and annual performance review. All services will be at no charge to Owner.
 - 2. Corrective Maintenance: Provide corrective maintenance operations. Corrective Maintenance shall include performing all required maintenance, repairs, and correcting any defects in workmanship of materials discovered during the one (1) year warranty period at no charge to Owner.
 - 3. Provide an emergency response phone number where the Maintenance Contractor can be reached at all times. Respond within four (4) hours of notification of any system problem, 24 hours per day, seven days per week including weekends and holidays. All problems and repairs shall be corrected and the system returned to full operation within 24 hours.
 - 4. Service work shall be performed by service personnel in the direct employ of the fire alarm contractor. The service technicians shall be factory trained and certified by the manufacturer to be competent in all aspects of the installed system. The technicians shall have a good working knowledge of the fire alarm system, calibration techniques, preventative maintenance, trouble shooting, software diagnostics and microprocessor repair.
 - 5. All work except emergency service maintenance shall be accomplished during the Owner's normal working hours, Monday through Friday excluding legal holidays as approved and pre-scheduled with the Owner. Contractor's workers shall report to the Owner prior to beginning of and upon completion of any service to the system. Precautions shall be taken to minimize disruption of facility

operations. Maintenance Contractor shall not begin any work upon the system until approval has been obtained from the Owner.

6. Maintenance Contractor is not responsible for vandalism or acts of God, however lightning storms are prevalent in the Tampa area and lightning claims shall be limited to problems caused by blips, spikes, etc., or any other variations in the power supply quality, which must be dissipated by TVSS devices, excluding direct hits by lightning.
-
- B. Maintenance Prior to Acceptance: Prior to formal acceptance and during the on-airport storage, installation and start-up of any equipment, the Contractor shall be responsible for the preventative maintenance and general protection from deterioration of all fire alarm equipment.
 - C. Spare Parts: Contractor shall provide a manufacturer's recommended spare parts list with recommended quantities and part numbers.
 - D. Maintenance Contractor shall obtain and maintain an inventory of recommended spares in the quantities required, including adequate other standard, proprietary, or vendor fabricated or modified parts required for routine maintenance of the system.
 - E. Technical Manuals
 1. Contractor shall supply two (2) copies and electronic copy of system technical and maintenance manuals. Manuals shall be compact and produced in such a manner that the maintenance personnel can easily refer to any of its pages or schematics for corrective and preventative maintenance.
 2. The technical manuals shall contain at a minimum the following information:
 - a. System description and operation.
 - b. Preventative and corrective maintenance schedules and instructions, including troubleshooting and diagnostics guidelines, schematics, and drawings for each component of the fire alarm system.
 - c. List of parts and part numbers.
 - d. Illustrated parts list.
 - e. Recommended spare parts list and source.

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SPECIFICATION SECTION 34 77 39

PART 1 - GENERAL

1.1 SUMMARY:

- 1.1.A. This specification Section (34 77 39) includes the performance specification, information contained herein, and PGD 100% (For Bidding) Drawing set and BHS BDR or supplemental documentation (annexes, et.al) provided for this project.
- 1.1.B. This specification is a performance-based description of the Baggage Handling System (BHS) work; the detailed design of the BHS is the responsibility of the BHSC. The extent of the BHS work is shown on the PGD 100% (For Bidding) drawings and is defined to include all labor, materials, equipment, and supervision required to furnish, fabricate, and install the BHS specified herein and the BHS work shall meet the spatial design and functional requirements of these contract documents.
- 1.1.C. Provide all necessary equipment to provide functional, complete, operable, and maintainable systems, which includes, but is not limited to:
1. Equipment including conveyor bed sections, drives, take ups, all transport of conveyor, static diverter, automated diverters (horizontal and vertical), sideguards, slope plate carousels, shrouding, floor supports, ceiling hangers and headers, panels and conveyor trim, warning beacons and audio messages, draft curtains, security/fire doors, controls, software, Uninterruptible Power Supplies (UPS), electrical equipment and materials, catwalks, platforms and access ladders, and guard rails as indicated or required to provide complete and operable systems.
 2. Coiling Security and Fire Doors as specified herein, including operation, controls, interfaces, and power as described in this section.
 3. Guardrails adjacent to conveyors and recirculating devices as indicated on the baggage system drawings.
 4. Stairs, crossover platforms, and maintenance crossovers to allow personnel access to remote conveyors are part of this Scope of Work. Stairs, railings, and metal fabrication requirements are specified in Division 05.
 5. Electrical work and controls for baggage handling equipment and related equipment (coiling doors, etc.), referenced in this section and on the baggage system drawings, unless noted otherwise.
 6. Interface connections and coordination as specified herein including but not limited to signage, fire alarm and smoke detection systems, as well as security access control system(s).
 7. Supervisory Control Systems located as indicated on the Baggage System Contract Drawings.
 8. Explosive Detection System (EDS) Interface - The scope of work includes, but is not necessarily limited to, coordination with the EDS provider and TSA for necessary provisions required for a complete operable interface with the equipment.
 9. Baggage Inspection Stations (BISs), [which include the Baggage Inspection Tables (BITs) and associated partitions, and hardware] for TSA operations are to be furnished as part of this Scope of Work. The coordination requirements are specified herein.
 10. TSO Supervisor's Desk is to be provided as part of this Work and the requirements are specified herein.

11. Checked Baggage Inspection System (CBIS) and Checked Baggage Reconciliation Area (CBRA) operational requirements – see appendix 34 77 39C. This information is Security Sensitive Information (SSI) and will only be provided to the BHSC after the Contract has been awarded to the successful bidder.
12. Testing and commissioning of the system is required for approval. This is inclusive all testing required by TSA or its authorized agency. These coordination requirements are in addition to the performance acceptance requirements specified elsewhere in this document.
 - a. All labor and materials are to be provided by the BHSC, except for the operations TSA’s equipment, unless directed otherwise by TSA. Pre-ISAT Testing requirements are to be based on the testing requirements herein, per the TSA’s ISAT requirements.
 - b. All signed off testing information is to be included in the Testing Readiness Report (TRR).
13. Badging:
 - a. Refer to General Conditions and Supplementary General Conditions and applicable provisions of Specification Divisions 00 and 01 for badging requirements.
 - b. All badging will be by the contractor. The owner and prime contractor will not sponsor any badging. Contractor must contact the airport for badging requirements for their employees.

1.1.D. Related Sections:

1. Division 00 – Procurement and Contracting Requirements (General Conditions and Supplemental General Conditions).
2. Division 01 – General Requirements.
3. General Conditions and Supplementary General Conditions and applicable provisions of Specification Divisions 00 and 01.
4. Concrete work, that are part of the BHS work, shall be provided in accordance with Division 03 – “Concrete”.
5. Metal Fabrications, that are part of the BHS work, shall be provided in accordance with Division 05, Section 05 50 00 - Metal Fabrications.
6. Metal Stairs, that are part of the BHS work, shall be provided in accordance with Division 05, Sections 05 51 00 – “Metal Stairs” and 05 51 19 – “Metal Grating Stairs”.
7. Ladders, that are part of the BHS work, shall be provided in accordance with Division 05, Sections 05 51 33 – “Metal Ladders”, 05 51 33 13 – “Vertical Metal Ladders”, 05 51 33 16 – “Inclined Metal Ladders”.
8. Metal Walkways/Catwalks, that are part of the BHS work, shall be provided in accordance with Division 05, Sections 05 51 36 – “Metal Walkways” and 05 51 36 13 – “Metal Catwalks”.
9. Pipe rails, that are part of the BHS work, shall be provided in accordance with Division 05, Section 05 52 13 - “Pipe and Tube Railings”.

10. Metal Gratings, that are part of the BHS work, shall be provided in accordance with Division 05, Section 05 53 00 – “Metal Gratings”.
11. Protective barricades and bollards that are not indicated as part of the baggage systems work on the baggage system drawings will be furnished and installed within the General Contract, unless noted otherwise. Refer to Specification Section 05 50 00.
12. Electrical requirements for general provisions, materials, and installations in accordance with Specification Division 26, latest adopted NEC, and local electrical code requirements, whichever is more stringent.
13. Communications requirements for general provisions, materials, and installations shall be in accordance with Specification Division 27, latest adopted NEC and adopted ANSI/TIA/EIA standards, and local communications code requirements, whichever is more stringent.
14. Access Control System will be provided within the General Contract and is specified in Division 28 Section 28 13 00 “Access Controls”. Controls interface with the BHS is described in this section.
15. Fire Alarm and Smoke Detection System will be furnished and installed within the General Contract and are specified in Specification Section 28 31 00. Controls interface with the baggage system is described in this section.
16. Coordinate with General Contractor for all Airport system(s) interface requirements. Controls and operational requirements are identified herein.

1.1.E. Materials/Workmanship:

1. Materials shall be of the quality specified herein, new, free from defects, of the best commercial/industrial grade, and approved by a nationally recognized testing laboratory wherever published standards exist.
2. Materials shall be standardized and of the same make and manufacturer throughout the project, wherever possible.
3. All bearings and bolts shall be of standard sizes and the number of different sizes shall be minimal where possible.
4. Steel and Connection Standards: Steel and connections shall meet the following standards in addition to those specified elsewhere in this document:
 - a. Structural plates shall conform to ASTM A-36.
 - b. Hot rolled sheets and coils shall conform to ASTM A A1011/A1011M.
 - c. Structural steel shapes shall conform to ASTM A-36.
 - d. All welding electrodes shall conform to AWS A-5.2. Use the standard code for arc and gas welding in building construction as a guide to general procedure and qualification of welders.
 - e. All fasteners shall be Grade 3 (SAE J429) and conform to ASTM A-307 Class 2A thread fit for bolts and Class 2B thread fit for nuts. All fasteners shall be zinc plated or equivalent. All fasteners shall be locked with locknuts or lock washers.

1.2 SUPPLEMENTAL REFERENCE DOCUMENTATION

1.2.A. Reference Standards:

1. Comply with the requirements of the reference standards noted herein, except where more stringent requirements are listed herein or otherwise required by the Contract Documents.
2. The publications of the codes and standards listed below form a part of this specification section to the same extent as if bound herein. The publications are referred to in the text by basic designation only.
3. All electrical work shall be in accordance with the latest applicable municipal electrical code and the NEC., whichever is more stringent.
4. All work shall be in accordance with the latest applicable municipal building code and the IBC, whichever is more stringent.

1.2.B. Additional Codes and Standards:

1. Federal Safety and Health Laws:

- a. All equipment and accessory items furnished and installed under this contract shall always be governed by applicable provisions of the Federal laws, including, but not limited to, the latest revisions of the following:
 - 1) William Steiger Occupational Safety and Health Act of 1970, Public Laws 91596.
 - 2) Part 1910 - Occupational Safety and Health Standards, Chapter XVII of Title 29, Code of Federal Regulations.
 - 3) Part 1926 - Occupational Safety and Health Standards, Chapter XVII of Title 29, Code of Federal Regulations.

2. Reference Documents:

- a. Airlines For America (A4A) – formerly Air Transport Association (ATA):
 - 1) Spec 101- (latest adopted edition) - Ground Equipment Technical Data;
 - 2) Copies of A.T.A. Spec. No. 101 may be obtained from Airlines For America (A4A), 1275 Pennsylvania Ave. NW, Suite 1300, Washington D.C. 20004.
 - 3) Internet address: www.airlines.org
- b. American Gear Manufacturers Association Standards (AGMA):
 - 1) ANSI/AGMA 6013-B16- (latest adopted edition) - Standard for Industrial Enclosed Gear Drives;
 - 2) ANSI/AGMA 6034-B92-R2016- (latest adopted edition) - Practice for Enclosed Cylindrical Wormgear Speed Reducers and Gearmotors;

- 3) ANSI/AGMA 6035-A02- (latest adopted edition) - Design, Rating and Application of Industrial Globoidal Wormgearing;
 - 4) Copies of AGMA Standards may be obtained from the American Gear Manufacturers Association, 1001 N. Fairfax Street, Suite 500, Alexandria, VA 22314-1587.
 - 5) Internet address: www.agma.org
- c. American National Standards Institute (ANSI):
- 1) ANSI/ASSE A1264.1- (latest adopted edition) - Safety Requirements For Workplace Walking/Working Surfaces And Their Access; Workplace, Floor, Wall, And Roof Openings; Stairs And Guardrail/Handrail Systems;
 - 2) ANSI Z535.1- 2017 (latest edition) - Safety Colors;
 - 3) ANSI/IEEE C2- (latest adopted edition) - National Electrical Safety Code;
 - 4) ANSI ASC A14.3- (latest adopted edition) - Ladders – Fixed – Safety Requirements;
 - 5) ANSI/NECA/BICSI 568- (latest adopted edition) - Installing Commercial Building Telecommunications Cabling;
 - 6) ANSI/NECA/BICSI 607- (latest adopted edition) - Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings;
 - 7) Copies of ANSI Standards may be obtained from the American National Standards Institute, 1899 L Street NW, 11th Floor, Washington, DC 20036.
 - 8) Internet address: www.ansi.org
- d. American Society for Testing and Materials (ASTM):
- 1) ASTM A36-14 (latest adopted edition) - Standard Specification for Carbon Structural Steel;
 - 2) ASTM A1011/A1011M- 18a (latest adopted edition) - Standard Specification For Steel, Sheet And Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy, high-strength Low Alloy With Improved Formability, And Ultra-High Strength;
 - 3) ASTM A307-14e1 (latest adopted edition) - Standard Specification For Carbon Steel Bolts, Studs, And Threaded Rod 60,000 PSI Tensile Strength;
 - 4) ASTM A563-15 (latest adopted edition) - Standard Specification For Carbon And Alloy Steel Nuts;
 - 5) Copies of ASTM Standards may be obtained from the American Society for Testing and Materials, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.
 - 6) Internet address: www.astm.org

- e. American Society of Mechanical Engineers (ASME):
 - 1) B20.1- (latest adopted edition) - Safety Standard for Conveyors and Related Equipment;
 - 2) B29.1- (latest adopted edition) - Precision Power Transmission Roller Chains, Attachments, And Sprockets;
 - 3) Copies of ASME Standards may be obtained from the American Society of Mechanical Engineers, Two Park Avenue, New York, NY 10016-5990.
 - 4) Internet address: www.asme.org
- f. American Welding Society (AWS):
 - 1) AWS A2.4:(latest adopted edition) - Standard Symbols for Welding, Brazing, and Nondestructive Examination;
 - 2) AWS C1.1M/C1.1:(latest adopted edition) - Recommended Practice for Resistance Welding;
 - 3) AWS D1.1/D1.1M:(latest adopted edition) - Structural Welding Code - Steel;
 - 4) AWS D1.2/D1.2M:(latest adopted edition) - Structural Welding Code - Aluminum;
 - 5) Copies of AWS publications may be obtained from the American Welding Society, 8669 NW 36 Street, #130, Miami, FL 33166-6672.
 - 6) Internet address: www.aws.org
- g. Canadian Air Transportation Security Authority (CATSA):
 - 1) National Explosive Detection System Deployment Plan for Hold Baggage Screening Recapitalization Program - Design and Project Management Guidelines, latest adopted version or as directed by CATSA (Restricted), latest adopted edition;
 - 2) Copies of CATSA Requirements may be obtained from the CATSA.
 - 3) Internet address: www.catsa-acsta.gc.ca
- h. Code of Federal Regulations (CFR):
 - 1) CFR 47 Part 15 (latest adopted edition) - Radio Frequency Devices;
 - 2) CFR 14 Part 108.17 (latest adopted edition) - Use of X-ray Systems;
 - 3) CFR 14 Part 129.26 (latest adopted edition) - Use of Airport X-ray Security Systems;
 - 4) Copies of CFRs may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.
 - 5) Internet address: www.access.gpo.gov

- i. Conveyor Equipment Manufacturers Association (CEMA):
 - 1) ANSI/CEMA 401- (latest adopted edition) - Roller Conveyor - Non-Powered;
 - 2) ANSI/CEMA 402- (latest adopted edition) - Belt Conveyors;
 - 3) ANSI/CEMA B105.1- (latest adopted edition) - Specification for Welded Steel Conveyor Pulleys with Compression Type Hubs;
 - 4) Copies of CEMA Standards may be obtained from the Conveyor Equipment Manufacturers Association, 5672 Strand Ct., Ste. 2, Naples, FL 34110.
 - 5) Internet address: www.cemanet.org
- j. Federal Aviation Administration (FAA):
 - 1) Federal Aviation Regulations, Part 108 (latest adopted edition);
 - 2) Copies of FAA Standards may be obtained from the Federal Aviation Administration.
 - 3) Internet address: www.faa.gov
- k. Federal Communications Commission (FCC):
 - 1) FCC Part 15 (latest adopted edition);
 - 2) Copies of FCC Standards may be obtained from the Federal Communications Commission, 445 12th St. SW, Washington, DC 20554.
 - 3) Internet address: www.fcc.gov
- l. International Air Transport Association (IATA):
 - 1) Passenger Standards Conference Manual (PSCM), latest adopted edition:
 - a) Resolution 740 – Form of Interline Bag Tag;
 - b) Resolution 753 - Baggage Tracking;
 - c) Recommended Practice 1740a - Baggage Tag Media Quality Guidelines;
 - d) Recommended Practice 1740b – License Plate Fallback Sortation Tag;
 - e) Recommended Practice 1740c – Radio Frequency Identification (RFID) Specifications for Interline Baggage;
 - f) Recommended Practice 1740d – Read and Sortation Rate in Baggage Handling Systems;
 - g) Recommended Practice 1745 – Baggage Information Messages;
 - h) Recommended Practice 1797b – Baggage System Interface;

- i) Recommended Practice 1800 - Automated Baggage Handling Based on IATA License Plate Concept.
- 2) Airport Development Reference Manual (ADRM), latest adopted edition;
- 3) Copies of IATA Standards, Resolutions, and Recommended Practices may be obtained from the International Air Transport Association, Publications Assistant, 800 Place Victoria, P.O. Box 113, Montreal, Quebec, Canada, H4Z 1M2; or IATA Centre, 33, Route de l'Aéroport, P.O. Box 416, 1215 Geneva - 15 Airport, Switzerland.
- 4) Internet address: www.iata.org
- m. International Civil Aviation Organization (ICAO):
 - 1) ICAO 8973 Security Manual (latest adopted edition) (Restricted);
 - 2) ICAO Annex 17 (latest adopted edition);
 - 3) Copies of ICAO Standards may be obtained from the International Civil Aviation Organization, 999 Robert-Bourassa Boulevard, Montréal, Québec H3C 5H7, Canada.
 - 4) Internet address: store.icao.int
- n. International Electrotechnical Commission (IEC):
 - 1) IEC 60204-1 (latest adopted edition) - Safety of Machinery - Electrical Equipment of Machines;
 - 2) IEC 60947-4-1 (latest adopted edition) - Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-Starters - Electromechanical Contactors and Motor-Starters;
 - 3) IEC 61508 (latest adopted edition) - Functional safety of Electrical/Electronic/programmable Electronic (E/E/PE) Safety Related Systems;
 - 4) IEC 62061 (latest adopted edition) - Functional Safety of Safety-Related Electrical, Electronic and Programmable Electronic Control Systems;
 - 5) IEC 529 (latest adopted edition) - IP Environmental Ratings;
 - 6) Copies of IEC Standards may be obtained from the International Electrotechnical Commission, 3, rue de Varembé, P.O. Box 131, CH-1211 Geneva 20, Switzerland.
 - 7) Internet address: www.iec.ch
- o. Institute of Electrical and Electronics Engineers (IEEE):
 - 1) IEEE 519 (latest edition) - Recommended Practice and Requirements for Harmonic Control in Electric Power Systems;
 - 2) Copies of IEEE Standards may be obtained from the Institute of Electrical and Electronics Engineers by contacting onlinesupport@ieee.org;
 - 3) Internet address: www.ieee.org

p. International Organization for Standardization (ISO):

- 1) ISO 9001:2000 Quality Assurance Systems;
- 2) ISO 12100 (latest adopted edition) - Safety of Machinery - General Principles for Design;
- 3) ISO 13849 (latest adopted edition) - Safety of Machinery - Safety-Related Parts of Control Systems;
- 4) ISO 13850 (latest adopted edition) - Safety of Machinery-Emergency Stop Function-Principles for Design;
- 5) ISO 13854 (latest adopted edition) - Safety of Machinery - Minimum Gaps to Avoid Crushing of Parts of the Human Body;
- 6) ISO 13855 (latest adopted edition) - Safety of Machinery - The Positioning of Protective Equipment in Respect to Approach Speeds of Parts of the Human Body;
- 7) ISO 13857 (latest adopted edition) - Safety of Machinery - Safety Distances to Prevent Dangerous Areas Being Reached by the Upper and Lower Limbs;
- 8) ISO 14118 (latest adopted edition) - Safety of Machinery - Prevention of Unexpected Start-up;
- 9) ISO 14119 (latest adopted edition) - Safety of Machinery - Interlocking Devices Associated with Guards - Principles for Design and Selection;
- 10) ISO 14120 (latest adopted edition) - Safety of Machinery - Guards - General Requirements for the Design and Construction of Fixed and Movable Guards;
- 11) Copies of ISO Standards may be obtained from the International Organization for Standardization, ISO Central Secretariat, BIBC II, 8, Chemin de Blandonnet, CP 401, 1214 Vernier, Geneva, Switzerland.
- 12) Internet address: www.iso.gov

q. National Electrical Manufacturers Association (NEMA):

- 1) NEMA ICS-1 (latest adopted edition) - Industrial Controls and System general requirements;
- 2) ANSI/NEMA MG-1- (latest adopted edition) - Motors and Generators – Includes Supplement;
- 3) Copies of NEMA Standards may be obtained from the National Electrical Manufacturers Association, 1300 North 17th Street, Suite 900, Arlington, VA 22209.
- 4) Internet address: www.nema.org

r. National Fire Protection Association (NFPA):

- 1) NFPA 70 - (latest adopted edition) - National Electrical Code National Fire Code, or latest adopted issue. Laws, rules, and regulations for installing electrical cabling, equipment, and components; and network cabling and related components and equipment;

- 2) NFPA 70E (latest adopted edition) - Electrical Safety in the Workplace, or latest adopted issue;
 - 3) NFPA 79 - (latest adopted edition) - Electrical Standard for Industrial Machinery, or latest adopted issue;
 - 4) Copies of NFPA publications may be obtained from National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.
 - 5) Internet address: www.nfpa.org
- s. National Institute of Standards and Technology (NIST):
- 1) FED-STD-H28 series- (latest adopted edition) - Screw Thread Standards;
 - 2) Copies of handbook H 28 may be obtained upon application accompanied by a money order, coupon, or cash, to the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.
 - 3) Internet address: www.nist.gov
- t. Telecommunications Industry Association (TIA):
- 1) TIA 526-14-C- (latest adopted edition) - Optical Power Loss Measurements of Installed MultiMode Fiber Cable Plant;
 - 2) TIA 568.0-D (latest adopted edition) - Generic Telecommunications Cabling for Customer Premises;
 - 3) TIA 568.1-D (latest adopted edition) - Commercial Building Telecommunications Infrastructure Standard;
 - 4) TIA 568.2-D (latest adopted edition) - Commercial Balanced Twisted Pair, Telecommunications Cabling And Components Standard;
 - 5) TIA 568.3-D (latest adopted edition) - Optical Fiber Cabling and Components Standard;
 - 6) TIA-569 (latest adopted edition) - Telecommunication Pathways and Spaces;
 - 7) TIA-606-C (latest adopted edition) - Administration Standard for Telecommunications Infrastructure;
 - 8) TIA-607-D (latest adopted edition) - Generic Telecommunications Bonding And grounding (Earthing) For Customer Premises;
 - 9) TIA-758-B (latest adopted edition) - Customer-Owned Outside Plant Telecommunications Infrastructure Standard;
 - 10) Copies of TIA Standards may be obtained from the Telecommunications Industry Association, 1310 North Courthouse Road, Suite 890, Arlington, VA 22201.
 - 11) Internet address: standards.tiaonline.org

- u. Transportation Security Administration (TSA):
 - 1) Planning Guidelines and Design Standards (PGDS) for Checked Baggage Inspection Systems (CBIS), Version 7.0
 - 2) CBIS Interface Requirements Document, Version 7.0;
 - 3) Re-insert Functions, RFV03 , see section 2.1.C.3. below.
 - 4) Copies of TSA Requirements may be obtained from the TSA.
 - 5) Internet address: www.tsa.gov/research/checked_baggage_material.shtm
- v. Underwriters Laboratories (UL):
 - 1) UL 6 (latest adopted edition) – Electrical Rigid Metal Conduit – Steel;
 - 2) UL 797 (latest adopted edition) – Electrical Metallic Tubing – Steel;
 - 3) UL 187 (latest adopted edition) – Standard for X-ray Equipment (Electrical);
 - 4) UL 60601-1 (latest adopted edition) – Safety Medical Electrical Equipment;
 - 5) UL 10B (latest adopted edition) – Standard Fire Tests of Door Assemblies;
 - 6) UL 508A (latest adopted edition) – Standard for Industrial Control Panels;
 - 7) UL 60947-4-1 (latest adopted edition) – Low-Voltage Switchgear and Controlgear – Part 4-1: Contactors and Motor-Starters – Electromechanical Contactors and Motor-Starters;
 - 8) UL 62 (latest adopted edition) – Flexible Cords and Cables;
 - 9) Copies of UL Standards may be obtained from the Underwriters Laboratories, UL Headquarters, 333 Pfingsten Road, Northbrook, IL 60062.
 - 10) Internet address: www.ul.com

3. Standards:

- a. The equipment covered by these specifications shall be designed, assembled and tested in accordance with the latest applicable standards of the National Electrical Manufacturers Association (NEMA) or International Electrotechnical Commission (IEC), the Institute of Electrical and Electronic Engineers (IEEE), the American National Standards Institute (ANSI), the International Organization for Standardization (ISO), the Conveyor Equipment Manufacturer's Association (CEMA), and Underwriters Laboratories (UL). All materials furnished shall be new, free from defects and UL-approved where such approval is granted to the equipment to be furnished. In addition to the above requirements, all applicable equipment shall conform to the most recently published applicable federal specifications and applicable OSHA specifications.
- b. Acceptance standards for weld performance and application shall be in accordance with the specifications for structural welding AWS D 1.1-88 and other applicable AWS specifications.

1.3 DEFINITIONS AND ABBREVIATIONS:

1.3.A. Abbreviations and Acronyms:

1. ACS: Access Control System
2. ADPM: Average Day / Peak Month.
3. AFF: Above Finish Floor.
4. AFS: Above Finish Slab.
5. AISC: American Institute of Steel Construction.
6. AISI: American Iron and Steel Institute.
7. ASCII: American Standard Code for Information Interchange.
8. ATO: Airline Ticketing Office.
9. ATR: Automatic Tag Reader.
10. AWS: American Welding Society.
11. BHS: Baggage Handling System.
12. BHSC: Baggage Handling System Contractor.
13. BIS: Baggage Inspection Station.
14. BMA: Bag Measurement Array.
15. BOS: Bottom of Steel.
16. BPH: Bags per Hour.
17. BRL: Baggage Reinsertion Line.
18. BRP: Baggage Removal Point.
19. BSD: Bag Status Display.
20. BVS: Baggage Viewing Station
21. CBIS: Checked Baggage Inspection System.
22. CBRA: Checked Baggage Reconciliation Area.
23. CT: Computerized Tomography.
24. DBU: Date of Beneficial Use.
25. DHS: Department of Homeland Security.

- 26. DPR: Design Performance Requirements.
- 27. EDS: Explosives Detection System.
- 28. EDSO: EDS Out-of-Gauge.
- 29. ETD: Explosives Trace Detection.
- 30. FADS: Fire Alarm and Smoke Detection System
- FAT: Factory Acceptance Test.
- 31. FDRS/MCC: Field Data Reporting System/Multiplex Control Console.
- 32. FIS: Federal Inspection Services.
- 33. FTE: Full-Time Equivalent.
- 34. GBIC: Gigabit Interface Converter.
- 35. HVAC: Heating, Ventilation, and Air Conditioning.
- 36. IATA: International Air Transportation Association.
- 37. ILDT: Integrated Local Design Team.
- 38. ISAT: Integrated Site Acceptance Test.
- 39. MCS: Master Control Station.
- 40. MEC: Manual Encoding Console.
- 41. MES: Manual Encoding Station.
- 42. OAR: Owner Authorized Representative.
- 43. OCR: Optical Character Reader
- 44. OOG: Out-of-Gauge.
- 45. O&M: Operations and Maintenance.
- 46. OS: Oversize.
- 47. OSR: On-Screen Resolution.
- 48. PE: Photoelectric Cell (Photoeye).
- 49. PGDS: TSA Planning Guidance and Design Standards.
- 50. PIV: Peak Inverse Voltage.
- 51. PLC: Programmable Logic Controller.

- 52. PVS: Primary Viewing Station.
- 53. QLR: Quick Look Report.
- 54. RFID: Radio Frequency Identification.
- 55. RRS: Remote Resolution Station.
- 56. SAT: Site Acceptance Test.
- 57. SSI: Sensitive Security Information.
- 58. SSTP: Site Specific Test Plan.
- 59. SVS: Secondary Viewing Station.
- 60. TCU: Threat Containment Unit.
- 61. THD: Total Harmonic Distortion.
- 62. TOB: Top of Belt.
- 63. TOG: Top of Grating.
- 64. TOS: Top of Steel.
- 65. TRN: Test Readiness Notification.
- 66. TRR: Test Readiness Review.
- 67. TSA: Transportation Security Administration.
- 68. TSR: Test Summary Report.
- 69. VFD: Variable Frequency Drive.

1.3.B. Definition of Terms:

- 1. Refer to the General Conditions and Supplementary General Conditions for additional definitions.
- 2. Access Control System (ACS): The security system 1) controlling/monitoring security door access, and 2) that enable the 'start' push buttons of the BHS.
- 3.
- 4. Alternate 1: See the Curbside Conveyor line: see PART 6
- 5. Alternate 2: Extended Warranty with Maintenance Services; See PART 6
- 6. As-Built: A comprehensive set of documents identifying the complete and final condition of the system.

7. Baggage Handling Systems (BHS): Transport system or systems of baggage transport equipment consisting of a complete system of static and dynamic mechanical and electrical components as specified in this section.
8. Baggage Handling System Contractor (BHSC): Installer/coordinator of baggage handling system equipment working as either a General/Prime Contractor or as a Subcontractor to a General/Prime Contractor.
9. Base Building Contractor/General Contractor/Prime Contractor (GC): General Contractor (GC) for Base Building Contract.
10. Building Steel: Same as Structural Steel and refers to the beams and columns that support the building structure.
11. CBIS Tracking Zone: The bag tracking conveyors from the tracking ID initialization point upstream of the EDS unit(s) and through the EDS line(s), OSR line(s), and the CBRA line(s) to the CBRA removal point(s).
12. CBRA Line: The conveyors that transport baggage from the OSR line to the CBRA removal points.
13. Checked Baggage Inspection System (CBIS): A subset of the Security Tracking Zone (STZ) from the point where each bag is tracked into and through the EDS screening area, to the “Clear” lines or Sortation lines that lead to the make-up area. Any subsystem or portion of a subsystem that transports bags that have not been cleared by EDS, OSR, or CBRA.
14. Clear Bag: Any bag that has received a “Clear” security screening decision from the EDS unit, from OSR, or from CBRA.
15. “Cleared” Decision Bag: The EDS unit issues one of three decisions on a bag: “CLEAR”, “SUSPECT/ALARM”, or “UNKNOWN”. The “Cleared” Decision Bags are bags that have been cleared by the EDS unit, or the OSR process, and can be sent to make-up.
16. Curbside Conveyor Line: Conveyor line that transport baggage from the curbside input to a collector conveyor line. For this PGD project, the curbside conveyor is defined as ‘Alternate 1’.
17. Design Defect: Any and all defect(s) of the design of the BHS/CBIS associated with; 1) Inappropriate action(s) of BHS mechanical or control system components during operational conditions, 2) an imminent safety hazard or occurrence of an accident during operational conditions, or 3) failure to meet “System Reliability” requirements herein.
18. EDS Conveyor Lines: Conveyors that transport baggage from diversion point on the Pre-EDS main line (outbound collector conveyor line – SF line) through the EDS unit to the diversion onto either the “Clear” conveyor line (CL) or the OSR conveyor line.
19. EDS “Unknown” Decision Bag: The EDS unit issues one of three decisions on a bag: “CLEAR”, “SUSPECT/ALARM”, or “UNKNOWN”. The EDS “Unknown” Decision (or EDS Fault Decision) Bag is usually caused by an internal fault in the EDS or when a Bag Jam occurs in the EDS, and the EDS unit cannot make a “CLEAR” or “SUSPECT/ALARM” decision. Images are not typically available. These EDS “Unknown” Decision bags and overflow bags are the only bags that can be reinserted into the system after reaching the CBRA. An “Unknown” Decision Bag is not a mis-tracked bag.

20. Header Steel: Steel member attached to or suspended from Structural Steel and/or Support Steel for attachment of Baggage System and or its supports.
21. Fire Alarm System (FAS): Fire alarm system for the building.
22. Input Conveyor Lines: Conveyors that transport baggage from inputs (ticket counter, or curbside) to other conveyor lines.
23. ISAT Testing: This testing is to be performed by the TSA approved contractor/representative.
24. “Lost” Bag: A “Lost” Bag is a bag that has lost its tracking before reaching its destination.
25. Main Lines:
 - a. Pre-EDS Main Lines: Conveyor line(s) where input lines are merged to create a main delivery conveyor line that delivers baggage for diversion to individual EDS shunt lines .
 - b. Post-EDS Main-Line Sortation Conveyor Lines: Conveyors that transport cleared baggage for sortation to make-up units, downstream sortation systems, or both. Conveyor line(s) where all EDS Clear lines, which includes EDS, OSR, and CBRA cleared baggage, are merged for transport to the make-up area.
26. Motor Control Panel (MCP): Enclosure for the BHS electrical and control components.
27. “No-Read” Bag: A “No-Read” Bag is a bag that is not read by the Bag Tag Reader Array (aka Automatic Tag Reader - ATR) because either the bag tag was not visible or readable, or the bag tag does not meet the specific bar code requirements for the reader array system.
28. Or Approved Equal: Allows products that are equal to the specific products listed but requires approval of an equal product through the substitution process.
29. Or Equal: Allows products that are equal to the specific products listed. Does not require approval of an equal product through the substitution process.
30. OSR Conveyor Lines: Conveyor lines after the EDS exit tunnel transporting baggage (that has not yet received a “Clear” security screening decision) to the Level 2 clear/alarm diversion point. Each individual EDS unit is likely to be connected to individual OSR lines that merge on to a main OSR line that transports baggage to the Level 2 clear/alarm diversion point.
31. “OSR No Decision” Bag: An “OSR No Decision” Bag is a “Suspect/Alarm” Decision Bag from the EDS unit that is reviewed by On-Screen Resolution and the reviewer does not make a decision on the bag because time has run out due to either the image being too complex for the operator to make a decision or the operator not reviewing the image in time. When a bag times out after being scanned by an EDS machine and the OSR operator does not make a decision, depending on how the system is set up (in the MCS), either a “Suspect/Alarm” decision can be rendered or an “Unknown” Decision can be rendered. Bags that are “OSR No Decision” shall remain as “Suspect/Alarm” Decision Bags for further screening to allow for directed search in the CBRA.
32. Outbound Collector Conveyor Lines: Conveyors that transport baggage from the ticket counter conveyor lines and curbside conveyor lines to the EDS conveyor line(s).
33. Owner: Charlotte County Airport Authority (CCAA)

- 34. Pre-ISAT Testing: This testing is to be performed by the BHSC as part of their internal testing to perform all tests required for ISAT Testing to prove that the system is ready for ISAT Testing.
- 35. Programmable Logic Controller (PLC): Controller for the BHS.
- 36. Request for Information (RFI): A formal written request to Owner from a bidder or BHSC requesting additional information or clarifications to the Specifications or plans.
- 37. Request for Substitution (RFS): A formal written request to the Owner from a bidder or BHSC requesting permission to substitute an approved equal product, component, service or action from one called out in the Specifications.
- 38. Structural Steel: Same as Building Steel and refers to the beams and columns that support the building structure.
- 39. Support Steel: Additional steel assemblies added to the structural steel to support header steel for the Baggage System supports.
- 40. Suspect Bag: Any Pre-EDS or Post-EDS bag that has not received a “Clear” security screening decision from the EDS unit, from OSR, or from CBRA.
- 41. “Suspect/Alarmed” Decision Bag: The EDS unit issues one of three decisions on a processed bag: “CLEAR”, “SUSPECT/ ALARM”, or “UNKNOWN/EDS ERROR” The “Suspect/Alarm” Decision Bags are bags that have been identified as suspect and require further screening through On-Screen Resolution and/or directed search in the CBRA. Images are available for On-Screen Resolution (OSR).
- 42. Ticket Counter Conveyor Lines: Conveyors that transport baggage from the ticket counter input to a collector conveyor line.

1.4 BHS CONTRACTOR QUALIFICATION REQUIREMENTS:

1.4.A. General:

- 1. The bidder (submitting BHSC) shall have a minimum of **ten (10) years** of successful experience in the baggage handling industry designing, manufacturing, installing and commissioning baggage handling systems with the following capabilities: bag tracking for sortation, IATA bag tag sortation, automatic tag readers, bag measuring arrays, merging of multiple lines into mainlines, management reporting of daily system performance, integration with airline reservation systems, fault monitoring and reporting, and other characteristics of fully integrated and automated systems. Provide a list of projects completed which demonstrate compliance with this requirement. Also, provide references, i.e., names and telephone numbers of clients served who have knowledge of the submitting BHSC’s performance in the areas noted.
- 2. The bidder (submitting BHSC) shall have successfully designed, manufactured, installed and commissioned a minimum of **three (3)** Baggage Handling System projects, complete with the characteristics noted above and including integration of Explosive Detection Equipment furnished by the Transportation Security Administration (TSA), **within the past five (5) years**, with each project being of similar size and scope to the Checked Baggage Inspection System proposed. Projects must have successfully passed TSA ISAT certification. Provide a list of projects completed which demonstrate compliance with this requirement. Also, provide references, i.e., names and telephone numbers of clients served who have knowledge of the submitting BHSC’s performance in the areas noted.

3. The bidder (submitting BHSC) shall have experience with a minimum of **two (2)** projects that included the integration of multiple Explosive Detection Units into an Automated Baggage Handling System in the United States **in the past five (5) years**; including testing and certification by the TSA. Projects must have successfully passed TSA ISAT certification. Provide a list of projects completed demonstrating compliance with this requirement. Also, provide references, i.e., names and telephone numbers of clients served who have knowledge of the submitting BHSC's performance on these successful projects.
4. The bidder (submitting BHSC) shall provide documentation that demonstrates strong, established and proven working relationships among the BHSC's selected team members. (This includes listing successfully completed and/or ongoing projects working with the team set forth)
5. The bidder (submitting BHSC) shall demonstrate that they have a suitably sized staff and manufacturing capability to meet peak phases of work. Provide a description of resource strategies that ensure staffing for this project.
6. The bidder (submitting BHSC) shall submit documentation that demonstrates its track record of meeting deadlines and working within a projected budget. The BHSC shall submit the project name/location and the client 's Point of Contact name, address, and phone number for three successfully completed projects.
7. BHS Project Manager: Subcontractor's project manager who has successfully completed the installation and commissioning in the previous **five (5) years of at least two (2) systems** of similar scope of Baggage Handling System as herein specified within the United States.
8. Installer: If the BHS is to be installed by an entity other than the BHSC Supplier, the Installer and its Supervisory personnel shall be listed on the bid forms and shall comply with the following requirements. Qualified personnel shall install the equipment with factory-trained and certified supervisors. Supervisory personnel shall each have at least **five (5) years** of successful experience with the installation of airport in-line baggage screening systems and BHS devices of the type specified herein.
9. Electrical Installer: If the Electrical Installation is by an entity other than the Supplier BHSC, the Electrical Installer and its Supervisory personnel shall be listed on the bid forms and shall comply with the following requirements.
10. The Electrical Installer shall have not less than **five (5) years continuous experience** in the installation of similar systems, as specified herein; including systems utilizing PLC operated motor control panels and controls, as specified herein.
11. Structural Engineer: The Baggage System Structural Engineer shall be responsible for the engineering of all Baggage System support steel, header steel, and seismic bracing, as required herein. The Structural Engineer shall be registered in the location of installation.

1.5 BHS CONTROLS CONTRACTOR QUALIFICATION REQUIREMENTS:

1.5.A. General:

1. The bidding controls team (submitting Controls Contractor/Subcontractor) shall demonstrate a minimum of **five (5) years** of successful experience in distributed and centralized power and drives, Motor Control Panels (MCPs), PLC programming with remote I/O systems using Ethernet/IP, HMI programming for baggage status display (BSDs) in CBRA as well as manual encode console, development of Sort Allocation Controller (SAC); Maintenance Diagnostic System (MDS); and Reporting system for the entire BHS (from ticket counters through CBIS to the sortation), integration (programming and commissioning) with EDS provider per IRD, and demonstrating FAT to the stakeholders. Provide a list

of projects completed demonstrating compliance with this requirement. Also, provide references, i.e., names and telephone numbers of clients served who have knowledge of the submitting contractor's performance in the areas noted.

2. The bidding controls team (submitting Controls Contractor/Subcontractor) must have at least **three (3)** Controls Engineers (or Software Engineers) who have experience with components listed above. In addition, Controls Engineers must have recent successful experience in positive bag tracking using shaft encoders and photoeyes through the conveying system and devices including vertical sorters, merges, diverters, along with dynamic bag spacing windows. Software Engineers must have recent experience in interfaces with BSM (via a DCS contractor such as SITA), development of dashboards, and server/network virtualizations. All engineers must have good understanding of industrial network security. Submit a resume of each qualified engineer including years of experience with components listed above.
3. The bidding controls team (submitting Controls Contractor/Subcontractor) shall have successfully designed, installed, and commissioned Controls systems for a minimum of **two (2)** Baggage Handling System (CBIS) projects **within the last five (5) years** with complex phases that require portions of the system to be operational during phasing. Provide a list of projects completed demonstrating compliance with this requirement. Also, provide references, i.e., names and telephone numbers of clients served who have knowledge of the submitting contractor's performance on these successful projects.
4. The bidding controls team (submitting Controls Contractor/Subcontractor) shall demonstrate the successful completion of a minimum of **two (2) successful BHS projects within the last five (5) years** that involve Controls Optimization such as PLC hardware replacement, server(s) replacement, adding new interfaces with other controllers (e.g. ATR, BMA, BSM, and FIDS) to the existing system, CBRA upgrade to the later version of PGDS. Provide a list of projects completed demonstrating compliance with this requirement. Also, provide references, i.e., names and telephone numbers of clients served who have knowledge of the submitting contractor's performance on these successful projects.
5. Control Engineering Team:
 - a. The control engineering team as a company shall have at least **two (2) Control Engineers**; and the firm shall have successfully completed the design, installation and testing of at least **ten (10) systems** of similar scope of Baggage Handling System. The BHSC shall submit the resumes of the control engineering team for approval (With Bid Documents).
 - b. A Senior Control Engineer shall be assigned to the project as Lead Control Engineer and shall continue to work on the project site for the project duration. No replacement shall be allowed without prior written approval from the OAR of the proposed replacement for the key personnel identified.
 - c. Controls Assembler: The electrical control panel and control station assembler shall have not less than **five (5) years** continuous experience in the assembly of PLC operated motor control panels. Motor control panels and control stations shall be assembled in an UL Listed shop.
 - d. If the BHS control and electrical engineering works include fabrication and installation that is subcontracted to other firms, the BHSC shall submit a list of subcontractors (With Bid Documents) for:
 - 1) Lower-level control software and hardware
 - 2) MCP and panel fabrications

3) Field wiring

- e. List shall indicate what percentage the subcontractor shall be responsible for its associated scope of work (With Bid Documents).
- 6. After award of project, the approved control engineering team and the subcontractors for upper-level control software and hardware, lower level control software and hardware, MCP and panel fabrications and field wiring shall not be replaced by others; their scope of work percentages shall not be changed.

1.6 SYSTEM DESCRIPTION:

1.6.A. General:

- 1. The Baggage Systems Work consists of installation of baggage handling equipment as shown on the Baggage System Contract Drawings. Baggage System components shall be new, in compliance with the requirements herein. BHSC shall provide components that comply with the requirements of these specifications. All subsystems listed below shall be considered as complete systems with interface to the overall system for testing purposes. Listed below are the systems that are to be provided and/or modified as part of this Work.
- 2. The work of this section defines the system components that the BHSC must furnish: all materials, equipment, labor, supervision, tools, and items necessary for the construction, installation, connection, testing, and operation of all of the conveyor mechanical and electrical work for this Project, as indicated on the Baggage System Drawings and described in this section of the specifications.
- 3. BHSC must perform a complete mechanical, electrical, and Controls field survey prior to preparation of Shop Drawings and must identify all conflicts created by or resulting from existing conditions or work by others.
- 4. BHSC may/shall propose minor adjustments to horizontal and vertical conveyor dimensions as needed to accommodate such conflicts and/or to meet the requirements of the Contract Documents while utilizing standard industry recognized equipment.
- 5. BHSC must perform a complete inspection and evaluation of all existing conveyors and controls and notify Project Manager or Construction Manager and Owner of any operating discrepancies. BHSC must supply a completely integrated and operable CBIS/BHS. All existing conveyor control systems must be incorporated into the new CBIS/BHS control system.

1.6.B. Installation:

- 1. BHSC must provide all necessary equipment to provide a complete, operable and maintainable system including but not limited to: conveyor bed sections, drives, take-ups, sideguards, shrouding, floor supports, ceiling hangers and headers, stainless steel panels and conveyor trim, fire/security doors, draft curtains, catwalks, platforms, access ladders, guard rails, control panels, conduit and wiring, all as necessary to provide a complete, operable and code-compliant system.
- 2. BHS system controls including interface with all baggage-related equipment and screening equipment and any other materials or equipment required to provide a complete, operable and maintainable system in complete compliance with this specification.

3. Submission of all shop drawings shall provide adequate details representing actual equipment to be installed. General installation details will not be accepted. Approval by OAR is required prior to any installation.

1.6.C. Descriptions:

1. Outbound Systems:

- a. The outbound system commences with a ticket counter line. The layout also shows the route of a 'curbside line (Alternate 1) which merges through the use of a 45-degree merge unit. A Bag Measuring Array (BMA) and an Automatic Tag Reader (ATR) shall be provided and all bags will pass through these devices; the BMA to determine bag size limits and the ATR for bag tracking. The BMA shall be configured to sense bags that will not pass through the aperture of the project EDS. Bags that are taller than 1" below the lowest portion of the EDS aperture shall be identified as Out-of-Gauge. Bags that are wider than 1" less than the aperture of the EDS shall also be identified as Out-of-Gauge. OOG bags, as determined by the BMA, will divert onto the OOG line, leading bags to CBRA for manual inspection.

Standard-sized bags will continue onto one of three EDS units configured as a 2+1 system: two primary EDS units and one redundant EDS unit for backup. A PE will be provided two-queue belts in front of each EDS. The PE will be positioned on struts vertically 1" less than the lowest part of the aperture of the EDS (to act as a back-up to the BMA). Bags that activate the PE shall stop the queue belt(s) of the shunt line and an alarm shall annunciate at the PE. A stack light and audible alarm shall be provided at the each OH PE.

A light curtain shall be provided 10" in front of the EDS. The light curtain shall be connected to the spacing queue belt(s) to control the gaps between bags entering the EDS,

Bags that exit the EDS and are deemed cleared by the EDS will be sent on 'clear' lines to the makeup carousel. Bags given a suspect designation will divert down onto the OSR line where TSO agents will have a minimum elapsed transport time of 45 seconds to review the images. If the bag is deemed cleared by the TSO, the 2nd chance divert will send the bags to the makeup carousel. If the bag is not cleared or no decision has been made by the TSO within a minimum of 45 second window the bag will be given a suspect designation and the 2nd chance vertical sort unit will send bags down to the CBRA area for manual inspection. The bags entering CBRA will be reconciled with the image produced by the EDS and the bag will be manually inspected by the TSO. Cleared bags will be placed in the clear line to be delivered to the makeup carousels. The CBRA area also has a re-insert line to allow bags to be inserted pre-EDS for re-scanning. In the event that a threat has been identified, the authorities are to be informed.

2. Outbound Oversize:

Oversize bags are to be portered to the oversized inspection table where they will be manually inspected by a TSO. Once the oversized bag has been inspected and cleared, the bag will then be portered to the makeup area.

1.7 SUBMITTALS:

1.7.A. General:

1. Refer to Specification Section 01 30 00 for submission procedures. Provide separate shop drawing submittals for each system or subsystem. Fabrication and installation shall not commence until shop

drawings and required data are submitted by the BHSC and approved by the OAR. After acceptance, no variations from the submittal data will be permitted except by written consent of the OAR.

2. It should be noted that additional submissions not included in the below listing may / will be required in accordance with the overall construction project requirements set forth elsewhere. At a minimum the following items must be included:

1.7.B. Documents Required:

1. Substitutions:
 - a. Approval of substitute products shall be considered only under the terms and conditions specified in Specification Section 01 60 00.
 - b. BHSC shall indicate its substitutions to the OAR in writing at time of BID. The BHSC shall not purchase any alternative products prior to obtaining the written consent from the OAR during the construction phase post BID phase.
2. Submittal Schedule: BHSC shall submit a schedule of submittals with delivery dates prior to submission of all other submittals and no more than 30 days after award of contract for review, comment, and acceptance. No other submittals will be accepted until this schedule is approved.
3. Material List: Submit a list of all materials, which shall be of the quality specified herein, new, free from defects, of the best commercial/industrial grade and approved by a nationally recognized testing laboratory wherever published standards exist, including specific catalog numbers where applicable, to the OAR and no more than 30 days after award of contract for review, comment, and acceptance prior to procurement.
4. Compliance List: Submit a "Compliance List" no more than 30 calendar days after award of contract for review, comment, and acceptance. The compliance list shall clearly identify every clause of this specification whether the BHSC fully complies, partially complies or does not comply. If the BHSC provides a statement of partial compliance or non-compliance, the BHSC shall include an explanation or suggest the associated substitutions. If the compliance list is not submitted within 30 calendar days after award of contract, the BHSC shall be considered to fully comply with the BHS specifications.
5. Work Schedules:
 - a. Submit comprehensive work schedule of BHS work as identified herein within 30 calendar days after award of contract for review, comment, and acceptance by the OAR. Identify clearly any modifications to the milestone dates provided in the contractors BID proposal schedule with justification for the change as well as mitigation efforts employed to ensure final delivery date is maintained.
6. Phasing/Sequencing Plans:
 - a. Provide a high-level sequencing plan identifying the primary execution methodology expected no more than 30 days after award of contract for review, comment, and acceptance. The general process is intended to follow that which is identified in the contract drawings however the BHSC may propose an alternate sequencing plan for review and consideration however the base sequence plan shall be based on the contract drawings and that which is specified elsewhere in this document. Refer to section 1.13 (Sequencing) herein for additional requirements.

- b. BHSC shall include a written narrative of sequencing identifying the proposed sequencing plan. The sequencing plan shall include, but not limited to, Phase 3 (where the majority of the BHS shall be installed / tested, and a ‘work around’ for Phase 4 where ticket counter bags must be portered round the existing ticket counter conveyors (which will be replaced) and the existing BHS/TSA equipment will be demolished..
 - c. For Phasing/Sequencing changes, the Phasing/Sequencing Plans and Schedules shall be updated and submitted to the OAR for review, comment, and acceptance.
- 7. Schedules:
 - a. Along with the Phasing/Sequencing Plans, BHSC shall include a Gantt chart roll up Schedule with a minimum of 3 levels outlining the Phases, Work packages, and subsequent Steps submitted to the OAR for review, comment, and acceptance. Refer to section 1.14 (Scheduling) herein for additional requirements.
 - b. Schedules shall be updated monthly and submitted to the OAR for review and coordination.
 - c. For testing, a schedule shall be developed and submitted to OAR review, comment, and acceptance.
- 8. Certification:
 - a. Submit certification that the supervisory personnel have the required training and experience to perform their responsibilities no more than 30 days after award of contract for review, comment, and acceptance.
 - b. Provide update submittals to this document during the project life cycle for all personnel replaced or added to the project team.
- 9. Installer's Qualifications: BHSC’s written approval of installer’s qualifications no more than 30 days after award of contract for review, comment, and acceptance.
- 10. Electrical Load Requirements: Submit, within 60 calendar days after award of contract, a summary of power distribution design data indicating the total connected load and greatest demand on the power supply.
- 11. Structural Load Calculations and Shop Drawings: Submit, 60 calendar days maximum after award of contract, structural shop drawings and detailed BHS structural components and connections calculations with illustrations prepared, signed and stamped by a registered structural engineer, licensed in the location of installation, for all conveyor and catwalk supports, additional steel members necessary for support, the stanchions for control station and pipe rail, all of which shall be engineered for seismic and structural loading.
- 12. Warranty Draft: Submit draft copy of warranty for review, comment, and acceptance by the OAR, as specified herein for complete operating baggage handling systems for Owner’s review. Submit within 60 calendar days after award of contract and include all specified inclusions. Refer to Part 5 of this specification for more warranty requirements.
- 13. Work/Contingency Plans:
 - a. Submit a detailed Work Plan for each installation requiring a shutdown, overnight changeover, and/or change in operation within 60 calendar days after award of contract. Work Plan submittal

shall identify tasks, duration of tasks, deadlines for overnight changeovers, back-up plans for missed overnight change-over deadlines, and Contractor's internal task deadlines; for review, comment, and acceptance by the OAR.

- b. Submittal shall be continually updated and submitted for review no later than 30 days prior to shut down, overnight changeover, and/or change in operation. Prior to and during the installation of overnight changeovers, the BHSC shall monitor the process and, in the event, that the completion deadline cannot be met, the approved back-up plan shall be implemented. Work Plan shall include, but is not limited to:
 - 1) Start and finish dates for the following activities:
 - a) BHSC's internal deadlines for completion of pertinent facility interfaces by other disciplines (e.g., permanent system power, support structures, etc.).
 - b) Overnight changeovers and scheduled turnover for each system.
 - c) BHSC's internal equipment testing.
 - d) System testing for each system.
 - e) Operational dates for each system with back-up plan for overnight changeovers and scheduled turnovers.
 - f) Final acceptance testing for each system with back-up plan for overnight changeovers and scheduled turnovers.
 - g) Pre-belting observation for review and punch-list preparation of items covered by the conveyor belting.
 - h) System observation and punch-list preparation of the system.
 - 2) Detailed description of demolition, removal, or alteration work for specific planned work. Provide back-up plan and dates.
 - 3) Detailed description of baggage handling system mechanical installation for specific planned work. Provide back-up plan and dates.
 - 4) Detailed description of baggage handling system structural installation for specific planned work. Provide back-up plan and dates.
 - 5) Detailed description of baggage handling system electrical installation for specific planned work. Provide back-up plan and dates.
 - 6) Detailed description of activities required to complete overnight changeovers to ensure that disruption to baggage handling services is kept to a minimum and within the limited time frames required on the phasing drawings. Include all preparatory work by all other trades. Provide backup plan for recovery of operations if changeover work will not be completed on time.
 - 7) Construction work plan for coordination and operational interface to ensure on-going Airport/Airline baggage handling operation is not disrupted.

- 8) At the beginning of each phase, submit a list of power outages required, indicating anticipated duration. All power outages shall be scheduled during low operations periods or during non-regular working hours. Power shall only be disconnected by approved personnel. Refer to Division 26 for scheduling of power outages. Power outages must be included in overall work plan schedule.

- 9) Sample Reports

The BHSC shall submit sample copies of the reporting requirement of PGDS V.7.0 (Chapter 12 and Appendix A) to include, but not limited to;

- a) CBIS Executive Summary report
- b) CBIS Performance report – daily
- c) ATR report
- d) Bag Data report
- e) Critical PE Tracking report
- f) BHS Faults report
- g) BHS Events report
- h) EDS Statistics report
- i) ATR Performance report
- j) BMA Statistics report
- k) System Baggage Volumes report
- l) CBRA Statistics report
- m) CBIS Hourly Throughput report
- n) PEC Tracking Statistics report
- o) Baggage Process Timer Statistics report
- p) BHS Bag ID Log report
- q) CBIS Bag Spacing report

The BHSC shall coordinate format modification with the CCAA and local TSA. The modified report (format) shall be refined no more than twice for final approval (from CCAA/local TSA) of the report formats.

14. Overall Description of Operations:

- a. BHSC shall submit a description of operation for review, comment, and acceptance for all systems, including interim and final configurations. The description of operation shall describe in detail the

logic and controls (hardware/software) proposed for each function and list all associated devices for each function. The description of operation shall be submitted with the shop drawing submission. Submittal shall be complete and include all systems identified herein.

- b. It shall be noted that the Owner's Operations team will operate the BHS:
 - a) Monitor the alarms and graphics panels in the BHS control room.
 - b) Resolve bag jams
 - c) Keep the BHS system operational,
 - d) Reviewing the 'contingency plan' and the implementation of a plan for operational needs
 - e) Contacting the Maintenance provider for corrections of ;
 - (1) Short term fixes
 - (2) Medium duration fixes
 - (3) Long term fixes

15. Product Data:

- a. Submit product data and cut sheets in an orderly bookmarked form in one comprehensive submittal after award of the Contract in accordance with Section 01 30 00 (Submittals) for all mechanical and electrical components provided for this Work. The equipment that is to be provided for this Work shall be clearly indicated appropriately with arrows, where multiple items are shown in the data. Partial lists and general catalogs will not be accepted. Failure to comply with these requirements shall be deemed as the Contractor's agreement to furnish the exact materials specified or materials based on these specifications. Product data shall be submitted prior to shop drawing submission. After acceptance, no variations from the submittal data will be permitted except by written in accordance with the substitution process described elsewhere.
- b. Provide manufacturer's product information on each component of BHS.
- c. Mechanical: Mechanical product data shall be separate from, not combined with, electrical/controls product data and shall be organized in format and naming for incorporation into the O&M Manual format.
- d. Electrical/Low Level Controls: Electrical/Low Level Controls product data shall be separate from, not combined with, mechanical or high-level controls hardware/software product data and shall be organized in format and naming for incorporation into the O&M Manual format.
- e. High-Level Controls Hardware/Software: High-Level Controls Hardware/ Software product data shall be separate from, not combined with, mechanical or electrical/low level controls product data and shall be organized in format and naming for incorporation into the O&M Manual format.

16. Shop Drawings:

- a. General:
 - 1) Assemble shop drawings into coordinated submittals. Drawings shall be complete, orderly and applicable to this installation only. Standard drawings properly referenced to assembly

drawings are acceptable. Only drawings stamped with acceptance by the OAR, as required by the General Conditions, Supplementary General Conditions, and/or Division 01, shall be used for fabrication and installation.

- 2) Shop drawing shall be of BHSC's own design. If not, the Owner will reject the drawing immediately, and any schedule impacts will be the sole responsibility of the BHSC.
- 3) Identify each part in reference to a bill of material which shall indicate each part name, number, description, quantity, size, gauge, model name and number of purchases, component, and reference to detail part drawings or assembly drawing, if required for fabrication.
- 4) Fully functional 3D model using a minimum LOD of 350 that can be utilized in common secondary software platforms (Navis-Works, BIM Tracks, Glue, etc.) for coordination and full BIM development.

b. Mechanical:

- 1) In addition to the submittal requirements specified in the General Conditions, Supplementary General Conditions, and/or Division 01, submit shop drawings for each conveyor system, existing BHS (if any) to be integrated into the complete functional BHS and all of its components, including layout (Existing, modified and new BHS), typical details of assembly, erection and anchorage drawn at large scale. Consolidated shop drawings for the items listed below shall be provided. Piecemeal submissions are not acceptable and will be rejected and returned. At a minimum, include the following items:
 - a) Location, type and load of supports, each reaction at building connection and lateral bracing; additional steel members necessary to support BHS and catwalk; specific vibration isolation devices and techniques utilized at each support. For vibration isolation, shop drawings shall indicate specific structural loads, isolation device type, and device rating at each support.
 - b) Layout plan of BHS with dimensions and elevations with components tied to the detailed bill of materials list. Section/Elevation drawings of the BHS keyed to the layout with components tied to the bill of materials list. Building and other building systems shown in the background for coordination.
 - c) Location, dimensions, and rating of drive units.
 - d) Stanchions for each load conveyor and carousel.

c. Electrical/Low Level Controls:

- 1) Wiring diagrams for the complete power distribution systems and control systems. Submittal shall be completed with summary index page, legend page, comprehensive electrical installation notes, detailed device layout, detailed part list, power load, wiring diagrams, conduit size, conduit routing layout, electrical components, control station layouts, system layout plan showing control locations, static system map, PLC layout, wiring of I/O, interfaces with other systems, VFDs, etc. Fuses to be identified by wiring diagram rung ID. Electrical shop drawings must be submitted together with a complete description of operation for the upper and lower-level controls.

- 2) Electrical/Controls Shop Drawings shall be submitted for review, comment, and acceptance. Controls/electrical work as identified herein shall not be started without approved shop drawings.
 - 3) Provide shop drawing detailing layout, front view, wiring schematics, material list, spare parts, etc. of each motor control panel.
 - 4) Wire numbers shall identify all wiring shown on controls/electrical drawings and shall be used for actual wire numbers in the field.
 - 5) All equipment shall be properly labeled on controls/electrical drawings.
 - 6) All equipment and wiring contacts shall be properly cross-referenced for easy review and installation.
 - 7) Static BHS map for each subsystem.
 - 8) Stanchions for each load conveyor and carousel.
- d. High Level Controls Hardware/Software:
- 1) Network Point to Point block diagram including field devices. Include fields for IP addresses for as-built purposes.
 - 2) Plan layout locating all BHS Server Racks and Network Racks for the Baggage Systems that are part of this Work.
 - 3) Layout of server racks, front and rear elevations, showing each component in each rack. Show how each rack is protected from environmental conditions.
 - 4) Layout of network racks, front and rear elevations, showing each component in each rack. Show how each rack is protected from environmental conditions, especially water spray in make-up areas.
17. Programming and Reports: Submit documentation on all software and customized programs as identified herein, and hard copy of PLC programming for review. Submit detailed printouts of all software display screens. A FINAL DRAFT printed copy (letter size) of the PLC programs shall be submitted along with a final draft copy of all the computer programming files prior to start-up. A final printed copy (letter size) of the PLC programs along with a final copy of all the computer programming files shall be included in the O&M Manuals.
18. Warranty Finalization: After the draft warrant submittal has been accepted in the submittal process, submit final copy of warranty for final review, comment, and acceptance by the OAR, as specified herein for complete operating baggage handling systems for Owner's review. Submit within 120 to 90 calendar days prior to completion of the system and include all specified inclusions. Refer to Part 5 of this specification for more warranty requirements.
19. HLC Factory Acceptance Test Plans: BHSC shall submit Test Plan(s) for the High-Level Control system for compliance with the requirements herein. The Test Plan(s) must be submitted by the BHSC to the OAR for review, comment, and acceptance 90 days prior to testing of the system(s). Include with the Test Plan(s) an agenda for the duration of the tests. Refer to Part 4 for Test Plan requirements herein.

20. HLC Site Acceptance Test Plans: BHSC shall submit Test Plan(s) for the High-Level Control system for compliance with the requirements herein. The Test Plan(s) must be submitted by the BHSC to the OAR for review, comment, and acceptance 90 days prior to testing of the system(s). Include with the Test Plan(s) an agenda for the duration of the tests. Refer to Part 4 for Test Plan requirements herein.
21. BHSC Internal Test Plans: BHSC shall submit Test Plan(s) for each system(s) for compliance with the requirements herein. The Test Plan(s) must be submitted by the BHSC to the OAR for review, comment, and acceptance 120 days prior to testing of the system(s). Refer to Part 4 for Test Plan requirements herein.
22. Commissioning Test Plans: BHSC shall submit Commissioning Plan(s) for each system(s) for compliance with the requirements herein. The Commissioning Plan(s) must be submitted by the BHSC for the OAR's review, comment, and acceptance 120 days prior to commissioning of the system(s). Refer to Part 4 for Commissioning Plan requirements herein.
23. Site Specific Test Plans: For all Checked Baggage Inspection Systems (CBIS) work to be accepted by TSA, the BHSC must submit a detailed Site-Specific Test Plan (SSTP) detailing all test procedures required by TSA's PGDS applied to the individual conditions of this project. The BHSC must receive acceptance for the SSTP in order to proceed with Commissioning of CBIS scope.
24. Spare Parts List: BHSC shall submit to the Owner's representative, at the time that the system(s) design engineering has been completed (both electrical as well as mechanical), a list of all parts used in the development of the system(s). Identify recommended and critical spare parts on the parts list and their prices for components. Identify what parts are not locally available and require shipping. Refer to Part 3 for Spare Parts requirements herein.
25. Preventive Maintenance and Schedule: The BHSC, prior to final acceptance of the equipment, shall provide a written program for preventive maintenance and a schedule of implementation the OAR for review, comment, and acceptance.
26. Training:
 - a. BHSC shall submit a training syllabus for concurrence by the Owner's representative at least 30 days prior to start of training.
 - b. Training shall not start until the syllabus and the training schedule is mutually agreed between the OAR and BHSC. Refer to Part 4 for Training requirements herein.
27. BHSC Internal Tests Signoffs: BHSC to submit signed off copies of the test plans for their completed internal testing to the OAR with sign-off of each activity in the test plan for review, comment, and acceptance. Submit within 48 hours from test completion. Signoffs will be used in the project closeout documentation.
28. Commissioning Tests Signoffs: BHSC to submit signed off copies of the test plans for the completed commissioning testing to the OAR with sign-off of each activity in the test plan for review, acceptance, and sign-off by OAR, Owner, and other applicable stakeholders. Submit within 48 hours from test completion. Signoffs will be used in documentation to applicable stakeholders and the project closeout documentation.
29. Site Specific Tests Signoffs: BHSC to submit signed off copies of the test plans for the completed site-specific testing to the OAR with sign-off of each activity in the test plan for review, acceptance, and sign-off by OAR, Owner, and other applicable stakeholders. Submit within 48 hours from test

completion. Signoffs will be used in documentation to applicable stakeholders and the project closeout documentation.

30. Deficiency Tracking Items Submission & Signoff:

- a. During testing period, BHSC is to submit to the OAR an electronic list of the BHSC's deficiency items and programming issues being tracked bi-weekly during internal test and weekly during commissioning testing for review of open items. List must identify the tracking number, description of item, status of item (open or closed), estimated date to be resolved, and date resolved. List must include all items opened and closed for proper tracking.
- b. Once deficiency open items have been resolved, BHSC is to submit signed off copies of the BHSC's deficiency items and programming issues being tracked to the OAR with sign-off of each deficiency item for review, acceptance, and sign-off by OAR, Owner, and other applicable stakeholders. Submit within 48 hours from completion of all deficiency correction. Signoffs will be used in documentation to applicable stakeholders and the project closeout documentation.

31. As-Built:

- a. Prior to project closeout, submit revised BHS mechanical, electrical and structural layouts and assembly drawings showing all field changes to the approved configuration signed and sealed by an engineer licensed in the state/district the work is performed in.
- b. Submit fully functional 3D model using a minimum LOD of 350 that can be utilized in common secondary software platforms (Navis-Works, BIM Tracks, Glue, etc.) for coordination and full BIM development.
- c. Mechanical Drawings:
 - 1) Complete As-Built drawings – Plans and Sections.
 - 2) All equipment shall be detailed and dimensioned down to the assembly level of detail and shall represent the actual installed conditions in all respects, general spatial representation blocks will not be accepted.
- d. Electrical Drawings:
 - 1) Complete As-Built schematics.
 - 2) Power and control device location layouts.
 - 3) Power and control device field terminations.
 - 4) MCP back panel layout diagrams.
 - 5) MCP door layout diagrams.
 - 6) Status panel layout diagrams.
 - 7) Control station faceplate and legend layout diagrams.

1.8 O&M MANUALS:

1.8.A. General:

1. Submit Operation and Maintenance Manuals as specified herein and in Specification Section 01 78 00. 90 days prior to completion, submit a draft copy for review in electronic format (PDF). The Owner or OAR shall indicate their acceptance or comments related thereto and return the draft to the BHSC.
2. Hardcopy O&M Manual versus Electronic Cloud Based O&M Manual: If an Electronic Cloud Based O&M Manual is acceptable to the Owner, then BHSC is to provide electronic version that is accessible via the internet by User ID and Password as required herein, otherwise a minimum of three hardcopy sets and three electronic searchable PDFs shall be provided.
 - a. Electronic Cloud Based O&M Manuals:
 - 1) Submit the final Electronic O&M Manual for access no less than 60 days prior to substantial completion or date of beneficial use, whichever occurs first, as specified, but prior to training of personnel. Electronic O&M Manual shall be provided with, but not limited to:
 - 2) Contents divided into folders with properly labeled tabs. Manuals shall include the drawings as built, operating and maintenance instructions, wiring diagrams, connections and complete parts list of all items. Include manufacturer's literature, sources of purchase and similar information. Content of manual shall be acceptable to the Owner.
 - 3) Security Protocols for Internet Cloud Based Operations.
 - 4) Secure User ID and Password Protection.
 - 5) Administrative Update Protection Protocols to limit accessibility and types of update.
 - 6) Archiving protocols for previous versions of updated information.
 - 7) Downloadability of materials in electronic searchable PDF format.
 - b. Hardcopy O&M Manuals:
 - 1) Submit the final O&M manual copies no less than 60 days prior to substantial completion or date of beneficial use, whichever occurs first, as specified, but prior to training of personnel. O&M Manual shall be provided with, but not limited to:
 - 2) These Manuals shall be bound in an orderly manner in loose-leaf lockable 3-ring binders with complete table of contents. A minimum of three hardcopy sets and three electronic searchable PDFs shall be provided.
 - 3) Contents shall be divided into sections separated by dividers with properly labeled margin tabs. Manuals shall include the drawings as built, operating and maintenance instructions, wiring diagrams, connections and complete parts list of all items. Include manufacturer's literature, sources of purchase and similar information. Content of manual shall be acceptable to the Owner.

3. Overall O&M Manual Contents: BHSC shall provide, but is not limited to, the following information in the O&M Manual:
- a. The O&M Manuals shall fully cover appropriate safety measures, precautions and instructions to be followed before, during and after making repairs, adjustments, clearing jams, or performing routine maintenance, which shall conform to all established Federal, State, and Local Safety Laws and Regulations.
 - b. O&M Manuals must be updated by supplement to reflect any field changes (by the BHSC), equipment changes due to warranty changes, etc., that were made during the warranty period of the system(s), so that all sets of the O&M Manuals shall reflect As-Built information.
 - c. In addition to the above general requirements, the operating section of the O&M Manual(s) shall include the following:
 - 1) Complete listing of electrical graphic symbols and reference designation per ANSI standards for all electrical equipment/components contained in the system(s).
 - 2) Summary, location, units controlled, and function of Pushbuttons, Photosensors, Limit Switches, etc.
 - 3) Normal system start-up and shutdown procedures of conveyor system(s).
 - 4) Detailed description of operational troubleshooting of the conveyor system(s).
 - 5) Product Data and Reference Documents.
 - 6) Mechanical Drawings:
 - a) Complete As-Built drawings – Plans and Sections.
 - 7) Electrical Drawings:
 - a) Complete As-Built schematics.
 - b) Power and control device location layouts.
 - c) Power and control device field terminations.
 - d) MCP back panel layout diagrams.
 - e) MCP door layout diagrams.
 - f) Status panel layout diagrams.
 - g) Control station faceplate and legend layout diagrams.
 - 8) Final printed copy (letter size) of the PLC and message center programs.
 - 9) Supervisory Control System Network:
 - a) Disks of all software used.

b) All hardware and software manuals.

c) All software licenses.

10) Final dynamic and static test results from BHSC Internal Site and Commissioning Tests shall be included in the final O & M Manuals for reference information.

1.9 REQUESTS FOR INFORMATION (RFIs):

1.9.A. General:

1. If the BHSC needs clarification on items relating to the Contract Documents, the BHSC must submit an RFI for each item formally to the Owner in writing in accordance with the overall contract requirements set forth in Division 01.
2. The RFI must reference an activity on the Progress Schedule and must note time criticality of the RFI, indicating time within which a response is required and priority when more than one RFI is submitted at the same time.
3. If the BHSC is satisfied with the clarification and does not request a change in Contract Sum or Contract Time, then the clarification will be executed without a change.
4. If the BHSC believes that the clarification results in a change in Contract Sum or Contract Time, then the BHSC must notify the Owner, who may then deny the request for change or issue an RFP.
5. The BHSC must not contract, purchase, or cause to be delivered any articles, devices, or material relating to the RFI prior to obtaining the written response from the Owner.
6. RFIs may not be used to request deviations or substitutions. The substitution process approved by the owner shall be followed.

1.10 QUALITY CONTROL:

1.10.A. Workmanship:

1. All workmanship shall be in accordance with the best commercial practice consistent with heavy-duty airport applications.
2. All materials and components furnished shall be new and free from defects. Used equipment, whether reconditioned or refurbished, is expressly prohibited.
3. Equipment is to be designed to meet the requirements of handling airline baggage.
4. All Equipment will be the current version of manufacture at time of NTP. When any product has available factory upgrades or modifications, such upgrades and modifications shall be fully implemented at the factory and receive full factory testing and certification.
5. Field installed equipment upgrades and modifications will not be conducted without written approval of the Owner.

6. Fabrication of all projections, welds, surfaces, and transfer points between conveyors shall be constructed and finished in a manner which eliminates damage to baggage which is considered to be conveyable, as described in section 1.11A below.
7. In addition to the Owner's Open Issues Log/Deficiency List, the BHSC shall identify and track deficiencies found during the installation and testing. All deficiency items must be resolved prior to completion acceptance.
8. For programming, the BHSC is to utilize Bug Tracking Tool software to identify and track programming bugs found during testing. All program bugs must be tracked in the tracking software and resolved prior to completion acceptance.

1.10.B. Standardization:

1. When multiple manufacturers are listed for a specific component within this specification, the BHSC shall use one specified manufacturer for a specific component.

1.10.C. Quality Control Resolutions:

1. During conveyor installation, Owner will perform inspections of the system.
2. All discrepancies found will be noted on the Owner's Open Issues Log. Items noted on the Owner's Open Issues Log will be brought up to the BHSC for discussion.
3. A resolution date for each item on the log shall be agreed upon with the BHSC.
4. At that time, the BHS will be given 24 hours to correct the discrepancy.
5. If the discrepancy is not corrected within 24 hours, a Letter of Non-Compliance will be issued to the BHSC.
6. The Letter of Non-Compliance will state the issue(s), when the issue was discovered, the specification reference to the issue, and the monetary value of the issue for which the BHSC will be responsible.
7. Discrepancies found during inspections that are determined by any safety inspector to be a safety or operations issue requiring immediate attention must be immediately addressed by the BHSC.

1.11 DELIVERY, STORAGE AND HANDLING:

1.11.A. General:

1. Delivery, storage and handling shall be in accordance with Specifications Section 01 60 00.
2. Necessary Protection of the work:
 - a. Methods of storage of conveyor materials shall protect the materials from weather, rust, air-borne grit and other construction debris. Deteriorated, including rusted equipment shall not be installed.
 - b. The BHSC shall coordinate with the Prime Contractor and/or OAR regarding Logistics transport, provide a weekly schedule update to include current and forecasted work information including, but not limited to:

- 1) Lay down area requirements per phase, sequence or work package;
- 2) Logistics transportation schedule;
- 3) Long Lead Item Order/Deliver schedule;
- 4) Warehousing Plan.

1.12 PROJECT/SITE CONDITIONS:

1.12.A. General:

1. Refer to Divisions 00 and 01, and the Contract Documents for additional project/site conditions.
2. Demolition of Existing Conveyors:
 - a. BHSC must demolish all required existing conveyors as identified within the plans and all temporary conveyors, including all conveyor bed sections, drives, take-ups, sideguards, shrouding, floor supports, ceiling hangers and headers, stainless steel panels and conveyor trim, fire/security doors, draft curtains, catwalks, platforms, access ladders, guard rails, control panels, conduit and wiring, all controls (back to source) to return the facility back to its original condition.
 - b. The Owner will have first right of refusal on all existing conveyor equipment to be removed. Any removed conveyor equipment remaining will become property of the BHSC and must be removed from the site in a timely manner. At no time will conveyor equipment to be removed remain on site in excess of 48 hours without written approval from the Owner.
 - c. Items that are identified by Owner for salvaging, but are not removed by the Owner, shall be delivered to the Owner within perimeter of Airport in coordination with the Owner. BHSC shall remove all mechanical and electrical items, raceways and wiring abandoned as a result of the various work items, unless otherwise noted. All raceways, wiring, associated fittings scheduled for demolition shall become the property of the BHSC, after the Owner has salvaged what items they require, and shall be removed from the premises. Do not reinstall existing raceways and wiring unless specifically indicated. The identified demolition items shall be recorded for both Owner items and BHSC items and the record shall be delivered to the Owner. Items to be demolished shall not be abandoned in place and shall be removed to the source.

1.12.B. Coordination of the Work:

1. The General Contractor and/or the Baggage System Contractor shall coordinate with all other trades on the project for the installation of the Baggage System equipment and verify that the right-of-way for the equipment is preserved.
2. They shall coordinate all wall and floor openings associated with the Baggage System for proper clearances in accordance with the requirements of the Contract Documents based on the equipment proposed for installation.
3. The BHSC shall field verify all existing conditions prior to the development of any shop drawings. The design documents provided are intended to verify the general right of way using industry standardized equipment. Due to BHSC's actual equipment used, these final routing dimensions may vary slightly from that which is shown on the bid documents. In all cases the BHSC shall confirm that the proposed

final installed product fits within the ROW provided. If a discrepancy is identified the BHSC shall notify the OAR immediately for further determination, coordination and resolution.

1.12.C. EDS Installation:

1. The BHSC shall coordinate with TSA and the EDS manufacturer for the installation of the EDS units.
2. EDS Units: The EDS units will be provided by TSA and installed by the TSA's subcontractor and the EDS manufacturer. The BHSC shall coordinate with TSA, the TSA's subcontractor, and EDS manufacturer for the installation and interface requirements. The BHSC shall make provisions for the installation of the EDS equipment prior to its arrival on site. This includes, but is not limited to, dismantling and reinstalling baggage system equipment that is in the way of the installation, providing centerline and conveyor end point markings on floor, making interface connections, fitting conveyors to the EDS units, and adjusting conveyor heights as necessary for the EDS units. Site Acceptance Testing for the EDS units will be the responsibility of TSA and the EDS manufacturer. Integrated Site Acceptance Testing for the CBIS will be the responsibility of TSA, EDS manufacturer, and BHSC. For TRR and iSAT, TSA's representatives are responsible for running the test, EDS manufacturer will be responsible for the operation of the EDS units, and BHSC shall provide support for the testing.
3. BHSC must coordinate with the TSA's designated suppliers for the installation, integration, and commissioning of all TSA-furnished equipment integrated into the BHS. BHSC is responsible for coordinating the work for all wiring, conduit and communication between the TSA-furnished equipment and the BHS to provide an operable system as described herein.

1.13 SEQUENCING:

1.13.A. General:

1. Refer to the project phasing drawings and the baggage system phasing drawings.
2. General planned Sequencing is identified below and is to be used as a general outline of the strategy developed. The BHSC may propose alternate sequencing steps for efficiency consideration as detailed in the formal Phasing/Sequencing Plan and Scheduling submission requirements.
3. Sequencing of installation may be referred to as Work Packages, Steps, Phases, etc. In all respects on this project, the BHS works shall be performed in a planned, scheduled, and formally executed process which minimizes the impacts to operations, is coordinated with the general construction works, supports the project timeline and schedule milestones and does not interfere with other ongoing projects at the Airport.
 - a. Phase 1: Air Terminal Site Civil – see the Civil sheets
 - 1) The Site Civil work (associated with the Air Terminal Extension) shall be completed.
 - b. Phase 2: Demolition of the existing exterior Air Terminal Building – see the Architectural sheets and the construction of the shell of the new Air Terminal Extension.
 - c. Phase 3: Interior Air Terminal Systems / Exterior Finishes
 - 1) The BHS-mechanical in the new Bagroom/CBIS/CBRA spaces shall be installed. Existing ticketing counter conveyor TC1-3 will be demolished, and a temporary roller deck will be

installed at the upstream end of new conveyor TC1-05. The remaining existing ticket counter conveyors, CBIS, and airside make-up carousel shall remain in operation throughout Phase 3.

- 2) The BHS-electrical in the new Bagroom/CBIS/CBRA/curbside spaces shall be installed.
- 3) The BHS-controls (Initial) in the new Bagroom/CBIS/CBRA spaces shall be installed.
- 4) The Base Building systems of the new Bagroom/CBIS/CBRA spaces shall be installed.
- 5) The EDS shall be SAT'd.
- 6) The BHS-controls (final) in the new Bagroom/CBIS/CBRA spaces shall be installed.
- 7) The pre-ISAT testing shall be completed.
- 8) The ISAT testing shall be completed.
- 9) Finishes in the TSA spaces shall be completed.
- 10) The TSA shall move operations to the new CBIS/CBRA

d. Phase 4: Existing Ticket Counter Replacement

- 1) The temporary roller deck upstream of TC1-05 will be used by porters to induct bags into the BHS until TC1-04 is installed. The existing ticket counter conveyors shall be demolished, including the takeaway belt at the T-merge.
- 2) The temporary roller deck will be demolished and TC1-04 will be installed and integrated, allowing porters to place bags directly onto this belt until the rest of the new ticket counter conveyors are installed and integrated. The BHSC shall provide temporary painted metal shrouding around TC1-04 for the safety of porters and ticketing agents until the rest of the ticket counter conveyors are installed along with proper stainless steel shrouding.
- 3) The rest of the new ticket counter conveyors (TC1-01 through TC1-03) shall be installed.
- 4) The existing CBIS, clear line, and exterior make-up unit shall be demolished.
- 5) Throughout Phase 4, the new BHS/CBIS/CBRA shall be operational.

e. Phase 5: Alternate 1 – Curbside Conveyors

- 1) Alternate 1 (which includes the curbside conveyors CS1-01 through CS1-11) is expected to be constructed after Phase 4 and the completion of the BHS as described in the base bid. However, at the airport's discretion, Alternate 1 may be constructed during Phase 3. In which case, it will be included in the ISAT testing. If Alternate 1 is installed after Phase 4, a CCR form will be completed and submitted to TSA.

1.14 SCHEDULING:

1.14.A. General:

1. BHSC shall develop a Gantt chart roll up Schedule with a minimum of 3 levels outlining the Phases, Work packages, and subsequent Steps in coordination with the Phasing/Sequencing Plans identified in section 1.13 (Sequencing) above.
2. Schedules shall be updated monthly and if Phasing/Sequencing Plans are changed.
3. For testing, BHSC is to develop a Schedule showing each test identified in the test plans with proposed test dates and times.

1.15 MAINTENANCE:

1.15.A. General Maintenance During Construction:

1. For each system or subsystem, while the system or subsystem is being tested, commissioned, or is operational, but has not been turned over to the Owner, the BHSC shall be responsible for all preventive and required maintenance until the system or subsystem is turned over to the Owner. Records of all preventive and required maintenance performed prior to turn over shall be kept and submitted to the Owner when the system or subsystem is turned over.
2. For each temporary/interim system or subsystem, the Baggage System Contractor shall be responsible for all preventive and required maintenance until it has been demolished. Records of all preventive and required maintenance performed shall be kept and submitted to the Owner when the system or subsystem is demolished.

1.15.B. The Baggage System Contractor, prior to final acceptance of the equipment, shall provide a written program for preventive maintenance and a schedule of implementation to be utilized by airport maintenance personnel for approval by the Owner. The program shall, as a minimum, identify, adjust where necessary to comply with manufacturer's specifications, and schedule procedural activities. At a minimum, the schedule for implementation of the maintenance plan shall provide for monthly performance of the maintenance procedures for the first 4 months and every other month thereafter. This information shall also be provided as a formal deliverable section in the Operations and Maintenance manuals.

1.15.C. The Baggage System Contractor, as part of the bid document, shall establish and incorporate a price for a 1-year preventive maintenance program and a schedule of implementation for consideration by the Owner. The program shall identify the functions to be performed, the frequency and schedule of routine and preventive maintenance functions, the maximum response time for emergency repair service and the staffing and other costs associated with providing the services.

1.15.D. At minimum, the program shall describe and schedule procedural activities for the following:

1. Lubricate all equipment periodically according to manufacturer's recommendations.
2. Check for unusual noise on all drive and roller assemblies.
3. Check the temperature of gearboxes and motors.
4. Check belt tension and tracking; check belts for wear and lacing.
5. Check alignment for shift on shafts, drive belts and chains, loose keys.

6. Check make-up devices for wear, catch points, guide wheel/guide track misalignment and drive component noise.
7. Operate all equipment and exercise all control functions.
8. Clean equipment to the extent that accumulated dirt or lubricants could affect wear or performance or mark baggage.
9. The Baggage System Contractor must respond within 24 hours to critical issues.
10. The Baggage System Contractor shall provide all materials, lubricants, consumables, tools, special tools and equipment necessary to accomplish equipment maintenance.
11. The Owner may, at their option, enter into contract with the Baggage System Contractor for preventive maintenance and repairs in future years beyond the scope of this specification.

PART-2 PRODUCTS/PERFORMANCE:

2.1 SYSTEM PERFORMANCE:

2.1.A. General:

1. This specification sets the performance criteria of the systems. Contractor shall be solely responsible for the detailed design, fabrication, and installation of the systems to satisfy the requirements herein.
2. Materials shall be of the quality specified herein, new, free from defects, of the best commercial/industrial grade, and approved by a nationally recognized testing laboratory wherever published standards exist. Materials shall be standardized and of the same make and manufacturer throughout the project, wherever possible.
3. Steel and Connection Standards: Steel and connections shall meet the following standards:
 - a. Structural plates shall conform to ASTM A-36/A36M-14.
 - b. Hot rolled sheets and coils shall conform to SAE J126-2015.
 - c. Structural steel shapes shall conform to ASTM A-36/A36M-14.
 - d. All welding electrodes shall conform to AWS A-5.2/A5.2M:2018. Use the standard code for arc and gas welding in building construction as a guide to general procedure and qualification of welders.
 - e. All fasteners shall be Grade 3 and conform to SAE J429. They must also conform to ASTM A-307-14e1 Class 2A thread fit for bolts and Class 2B thread fit for nuts. All fasteners shall be zinc plated or equivalent. All fasteners shall be locked with locknuts or lock washers.
 - f. All bearings and bolts shall be of standard sizes and the number of different sizes shall be minimal, where possible.
4. Interface between EDS equipment and BHS equipment shall be in compliance with TSA's and/or ECAC Interface Requirements Document (IRD), latest version.

2.1.B. Assumptions:

1. This specification, a part of the contract documents, is a functional performance specification. The BHSC agrees to provide the work of this specification, as defined herein, to meet the functional performance requirements.
2. The BHSC shall develop a schedule of work, defining all tasks, to include those that require night work, tasks out of the construction barriers, and tasks that impact airport or airline systems.
3. Where tasks must be accomplished outside of the construction barriers, or where tasks impact the airport or airline systems, the BHSC shall be aware that the hours of airline operation are from 0400 to 2100 (The BHSC shall confirm the operation hours).

2.1.C. Performance Requirements:

1. The BHS is to be designed / constructed to serve the performance standards listed herein.

- a. The BHS shall not have jams in excess of 1%. This is calculated by taking the total number of bag jam events divided by the total number of bags in a 24-hour period. Three (3) bags shall be counted in any given bag jam.
2. System Processing:
- a. Load Conveyor: 1368 Bags Per Hour
 - b. Transport Conveyor: 1368 Bags Per Hour
 - c. System Throughput Rates and Speeds:
 - 1) Conveyor Inputs: Input conveyors at ticket counters, and curbsides (Alternate 1) are set at 90 feet per minute, unless noted otherwise. Refer to Contract Documents for load and unload conveyor speeds in system.
 - 2) CBIS: The baggage system shall be engineered and installed to process a maintained throughput of 1368 Bag Per Hour (BPM) through each EDS unit for typical 28-inch bags with 12 inch spacing. The input conveyor in front of the EDS unit shall be able to pass bags to the EDS unit at a speed of approximately 15.7 inches per second, as required and shall be adjustable through the VFD. The output (external exit) conveyor immediately after the EDS unit are to be set at approximately 17 inches per second, as required and shall be adjustable through the VFD. Actual speeds on the security screening line conveyors (upstream and downstream) shall be directly coordinated with the EDS supplier and shall conform with the requirements necessary to meet the manufacturers published rates. Refer to EDS installation and integration manuals for conveyor speed requirements. Use of VFDs on these conveyors is required.
 - 3) Total time in system shall not exceed 10 minutes from furthest input to the furthest make-up for 95% of the bags.
 - d. System Reliability:
 - 1) Subsystem Availability (SA): Each subsystem of the baggage system shall have an availability of not less than 99.5% to be calculated on a monthly basis. Subsystem Availability (SA) shall be defined as follows, where n = subsystem number:

$$SA_n = \frac{ST_n - RT_n}{ST_n}$$
 - a) Scheduled Operating Time (ST) shall be the scheduled time that the baggage handling system is available for baggage processing as defined herein.
 - b) Repair Time (RT) shall be the interval of time between initiation of repairs due to failure and return of the baggage system to operation.
 - 2) System Availability (A): The overall baggage system shall have a system availability of not less than 96.0% to be calculated on a monthly basis for the first 60 days of full operation. Within the first 60 days, the system shall reach and maintain an average System Availability of not less than 99.0% to be calculated on a monthly basis. System Availability (A) shall be defined as follows, where N = the total number of subsystems:

$$A = \frac{SA_1 + SA_2 + SA_3 + \dots + SA_N}{N}$$

- 3) The maximum allowable downtime in a single operating day shall not be more than 15 minutes on one subsystem. The accumulative downtime for all subsystems in a single operating day shall not exceed 20 minutes.
- 4) Baggage system computers, servers, network equipment, PLC's, workstations, and any other control equipment within any master/slave pair shall not have more than one failure per month for any one unit.
- 5) All baggage system computers, servers, network equipment, and control systems shall have an availability of not less than 99.9% to be calculated on a monthly basis. The maximum allowable downtime in a single operating day shall not be more than 2 minutes for a single event. The maximum downtime where both master/slave pair fail simultaneously shall not exceed 10 minutes in a year.

e. Bag Tracking:

- 1) Conventional Baggage System Bag Tracking: Bags shall be read at an Automated Tag Reader (ATR) Array (and/or RFID Reader Array) to identify the bags IATA 10 Digit Bag Tag number and link it to a BHS assigned Unique Tracking ID number used by the baggage system for tracking the bag. Bags that are No-Reads at the ATR shall be linked to the Unique Tracking ID.
- 2) Bag Tracking in the Checked Baggage Inspection System (CBIS) portion of the Baggage System:
 - a) Conventional Baggage System CBIS Bag Tracking: The baggage system shall positively track each bag entering the CBIS tracking zone by the assigned Unique Tracking ID number, along with the IATA 10 Digit Bag Tag ID. Tracking the bags progress shall be by monitoring conveyor speeds/tachometer signals, distances, routing events, and other information associated with its travel path through the tracking zone. The baggage system shall be capable of tracking and handling bags during adverse event conditions that are typical situations that occur in normal baggage handling system operations.
 - b) The bag's Unique Tracking ID number and IATA 10 Digit Bag Tag ID shall be the IDs that are transferred between the BHS and EDS equipment.
 - c) Bags lost in tracking (mis-tracked bags) shall be less than 1.0% of total bags in a 24-hour period for the system.
 - d) Bag tracking shall not incorporate "First In, First Out" (FIFO) logic.
 - e) RFV03 shall be followed for BHS Unknown bags; see RFV03 language below.
 - f) Error Bags at Checked Baggage Reconciliation Area (CBRA): The acceptable error rate varies depending on whether the design includes a Baggage Reinsertion Line (BRL). Error bags are all bags that arrive at CBRA that are not valid EDS Out-of-Gauge bags or are not valid non-clear bags with BHS tracking ID numbers.
 - (1) With a BRL, the acceptable error rate at CBRA shall be 2% unknown and no greater than 3% total error bags.

- (2) Without a BRL, the acceptable error rate at CBRA shall be 1% unknown and no greater than 2% total error bags.
- g) At no time shall the baggage system swap BHS tracking ID numbers on bags or security screening decisions on bags.
- h) The baggage system shall be capable of detecting when any bag infringes on the tracking window of any other bag, provided that the bags are equal to or greater than 12 inches running parallel with the conveyor and the bag is not on top of, underneath, or directly beside another bag. The baggage system shall be capable of detecting a bag that is leading edge to trailing edge or trailing edge to leading edge with another bag and route the bags appropriately.
- i) In tracking areas, where all bags must be retained and tracked with the status from the EDS, the BHS shall at no time override a decision provided from the EDS, except when a decision has not been received from the EDS and the BHS must assign a status for tracking purposes. This assigned status shall be clearly identifiable as a bag, which has not received a decision from the EDS.
- j) The bag tracking portion of the CBIS shall detect when a bag is missing from the system and identify it in the appropriate reports.
- k) The CBIS shall detect when a bag has been accelerated or delayed more than 12 inches. Requirements are as follows:
 - (1) For accelerated or delayed single bags upstream of the EDS, the BHS shall reacquire the bag, assign it a new pseudo tracking ID, and continue tracking the bag.
 - (2) For accelerated or delayed single bags traveling downstream of EDS, where the bag has already been screened, any security status assigned to the bag shall no longer be considered valid. The bag shall be assigned a new pseudo tracking ID and routed to the CBRA.
 - (3) For accelerated or delayed multiple bags traveling downstream of EDS, where the bags have already been screened and tracking windows have been infringed upon, any security status assigned to the bags shall no longer be considered valid. All bags involved shall be assigned new pseudo tracking IDs and routed to the CBRA.
 - (4) Refer to TSA's PGDS for testing standards related to accelerated and delayed bags. CBIS shall be capable of passing these tests:
- l) Added Bag: The CBIS shall detect when a bag has been added within the CBIS tracking zone, provided that the bag is not placed on top of, underneath, or directly beside another bag. Requirements are as follows:
 - (1) Upstream of EDS (Single Bag): For added single bags upstream of the EDS, the BHS shall acquire the bag, assign it a pseudo tracking ID, and continue tracking the bag.
 - (2) Downstream of EDS: If a bag is added downstream of the EDS and only the added bag itself is affected (added bag does not infringe on the tracking window of another bag), then the bag shall be assigned a new pseudo tracking ID and routed to the CBRA.

- (3) Refer to TSA's PGDS for testing standards related to added bags. CBIS shall be capable of passing these tests.
 - m) The CBIS shall maintain bag tracking and security statuses of all bags that have been screened by the EDS and the security decision transmitted from the EDS to the BHS prior to and after activation and restart of either a BHS or EDS emergency-stop (E-Stop). The EDS will recover from the E-Stop condition in accordance with published criteria from the EDS vendor and shall not be impacted by the BHS. The BHS shall recover from the E-Stop condition as identified herein.
 - n) The CBIS shall maintain bag tracking and security statuses of all bags that have been screened by the EDS and the security decision transmitted from the EDS to the BHS prior to and after activation and restart of a BHS head-end (cascade) stop condition due to a fault or die-back condition.
 - o) Photoelectric Sensors and Tachometers shall be used for all bag tracking. Virtual bag tracking methods are not acceptable.
- 3) Bag Tracking in Sortation and Other Tracking Portions of the Baggage System:
- a) Under testing conditions, there shall be no bags lost in tracking (mis-tracked bags) unless it is caused by an improperly loaded or damaged bag. Under normal operating conditions, bags lost in tracking shall be less than 2.0% of total bags in a 24-hour period. If bags lost in tracking reaches 2.0%, then the system must be monitored to identify the cause of the tracking problem and make appropriate modifications if the cause is found to be due to the baggage system and not improperly loaded or damaged bags. The Owner's representatives must agree with the contractor's findings as to the cause of the tracking issue before the contractor can dismiss the tracking issue as a non-BHS issue.
 - b) Under testing conditions, there shall be no bags mis-sorted unless it is caused by an improperly loaded or damaged bag. Under normal operating conditions, mis-sorted bags shall be less than 1.0% of total bags in a 24-hour period. If mis-sorted bags reach 1.0%, then the system must be monitored to identify the cause of the sorting problem and make appropriate modifications if the cause is found to be due to the baggage system and not improperly loaded or damaged bags. The Owner's representatives must agree with the contractor's finding as to the cause of the mis-sorting issue before the contractor can dismiss the mis-sorting issue as a non-BHS issue.
 - c) The BHS shall maintain bag tracking upon activation and restart of a BHS E-Stop or head-end (cascade) stop condition due to a fault, die-back, or emergency condition.
 - d) Photoelectric Sensors and Tachometers shall be used for all bag tracking. Virtual bag tracking methods are not acceptable.

3. The RFV 03 language is inserted below:

- 1. EDS Error or Lost-In-Track (LIT) bags arrive at BRP (Not Removed from BRP).
 - a. If the bag has not been removed from the BRP and the bag is to be reinserted
 - i. The TSO will press the reinsert button on the Bag Status Display (BSD).

- ii. The bag will remain stopped until the TSO scans the IATA tag with the scan gun at the BIS.
 - 1. Per PGDS v7 section 14.5.6, the bag shall be assigned a new unique BHS tracking ID.
- iii. A message will pop up on the BSD that states “Scan Bag Tag To Release Reinsert Bag” (See Figure 1).
- iv. Once scanned, the conveyor will automatically start, and the bag will proceed down the Alarm Line and onto the Reinsert Line without stopping.

Figure 1: Reinsert bag process screen at BIS

 Transportation Security Administration		Station - 01	DISABLE
Bag Status: EDS ERROR		RBS Level: 1	
IATA ID: 7410852963		Pseudo ID: 0123456789	
EDS ID: SS1 (G500)			
SCAN BAG TAG TO RELEASE REINSERT BAG			
REINSERT		SEARCH	

- b. If for any reason the bag becomes LIT prior to RI-01, the bag will stop at RI-01 for manual reinsertion.
- 2. EDS Error or Lost-In-Track bags arrive at BRP (Removed from BRP).
 - a. If the bag has been removed to the BIS and the bag is to be reinserted:
 - i. The TSO will press the reinsert button on the BSD.
 - ii. Once the BRP is clear, the conveyor will stop (bags will be held of the BRP so bag can be reinserted).
 - iii. The TSO will place the bag on the conveyor at the headend photo eye (PE).
 - iv. A message will pop up on the BSD that states “Scan Bag Tag To Release Reinsert Bag”.
 - v. The bag will remain stopped until the TSO scans the IATA tag with the scan gun at the BIS.
 - 1. Per PGDS v7 section 14.5.6, the bag shall be assigned a new unique BHS tracking ID.
 - vi. Once scanned, the conveyor will automatically start, and the bag will proceed down the Alarm Line and onto the Reinsert upstream Line without stopping.
 - 1. If for any reason the bag becomes LIT prior to RI-01, the bag will stop at RI-01 for manual reinsertion.

3. Manual Reinsertion Point

- a. The system will include a Manual Reinsertion Point per PGDS v7 section 14.5.6, and it will include a control station with an “Release Bag” pushbutton and an E-Stop as well as a BSD with reinsert instructions with graphics indicating where to place the bag on the conveyor and when to scan the bag tag.
 - I The “Release Bag” function on the control station will act as an override if for any reason a bag does not have a bag tag, or if the BSD or scan gun become non-functional for any reason.
 - ii. The Manual Reinsertion Point scan gun will act as the primary function to process a reinsert bag at the Manual Reinsertion Point and will fulfill the requirement of having the reinserted bag tag scanned prior to re-screening.
- b. For a bag that comes from a BIS automatically and has become lost prior to the Manual Reinsertion Point:
 - i. The bag will stop at the Manual Reinsertion Point.

- ii. A unique audible and visual alert will sound to notify TSOs that there is a bag at the reinsertion point.
 - 1. Note: There will be no audible or visual alert for a bag that was reinserted from BIS and maintains track down the Alarm Line and reinsertion point conveyor.
- iii A TSO will ensure the bag is correctly oriented on the conveyor and does not need intervention i.e. placed in a tub, straightened, or flipped over “wheels up,” etc.
- iv. The IATA bag tag is scanned using the scan gun at the Manual Reinsertion Point per the steps on the BSD.
- v. Once scanned, the conveyor will automatically start, and the bag will proceed down the Reinsertion Line.

c. For a bag that is hand-carried to the Manual Reinsertion Point:

- i. The TSO will place the bag onto the Manual Reinsertion Point conveyor blocking the headend photo eye per the steps on the BSD.
- ii. The IATA bag tag is scanned using the scan gun at the Manual Reinsertion Point.
- iii. Once scanned, the conveyor will automatically start, and the bag will proceed down the Reinsertion Line.

2.1.D. Mechanical Design:

- 1. The BHSC shall be responsible for the detail design, fabrication, and installation of the systems to satisfy the requirements herein.
- 2. The drawings depict substantial physical and dimensional constraints necessary for coordination with the building structure, the mechanical and electrical equipment within the limited building envelope. The design represents functional requirements of the stakeholders. Minor alterations to the design to accommodate the BHSC’s equipment shall be left to the discretion of the BHSC. Verify all given dimensions and obtain all other required dimensions from actual field measurements. The conveyor equipment schedule on the drawings is only intended for reference. Detail system engineering shall be the responsibility of the BHSC/manufacture in accordance with good design practice for airport BHS.
- 3. Baggage Characteristics:
 - a. The equipment for standard size bags shall be capable of conveying baggage of various sizes and shapes with dimensions not to exceed 34” (860mm) high x 34” (860mm) wide. Lengths of baggage, in general, will not exceed 54” (1370mm). Baggage larger than 24” (860mm) high, 34” (860mm) wide, or 54” (1370mm) long shall be considered oversize baggage and not placed into the standard bag BHS. The equipment for oversized bags shall be capable of conveying baggage of various sizes and shapes with dimensions not to exceed 38” (965mm) high x 40” (1015mm) wide. Lengths of baggage, in general, will not exceed 78” (1980mm). Baggage larger than 38” (965mm) high, 40” (1015mm) wide, or 78” (1980mm) long shall be considered non-conveyable and handled manually.

- b. The minimum size of conveyable baggage is presumed to be 4" (100mm) high by 12" (305mm) wide by 12" (305mm) long. The conveyable baggage under 12" (305mm) shall be conveyed in a tub. Bags that are less than 15 pounds (6.8 kg) shall be placed in tubs.
 - c. The maximum weight per piece of baggage shall be assumed to be 100 lbs. (45 kg). The live load is assumed to be 40 lbs. per lineal foot at 90 fpm (60 kg per lineal meter at 0.46 m/s) loading belts. Minimum live load is 25 lbs. per lineal foot (37.5 kg per lineal meter). All accumulating, load and unload conveyors shall be designed for a live load of 60 lbs. per lineal foot at 90 fpm (90 kg per lineal meter at 0.46 m/s). All conveyor equipment shall be capable of supporting a single concentrated load of 250 lbs. (114 kg).
4. Clearances and Configuration:
- a. Conveyor lines shall be engineered and installed to have a minimum of 34" (915mm) baggage clearance above the belt surface for standard bags. Oversize conveyor lines shall be engineered and installed to have a minimum of 40" (1015mm) baggage clearance above the belt surface for standard bags.
 - b. Conveyors and associated catwalks installed over driveways and cart/container parking zones shall provide at least 8'-0" (2.44 m) clearance to the lowest hanger of the catwalk, conveyor or drive components, unless noted otherwise on drawings. Conveyors and associated catwalks installed over the walkways or work areas shall provide at least 7'-6" (2.3 m) clearance to the lowest hanger of the catwalk, conveyor or drive components, unless noted otherwise on drawings.
5. Maximum Angles:
- a. Non-Trackled Zones: For conveyor transporting normal sized baggage, the maximum angles of inclines and declines shall not exceed 18 degrees from the horizontal in non-tracking zones, unless noted otherwise on BHS Contract Drawings. In some locations, angles greater than 18 degrees may be required and at these locations, the slope shall not exceed the angle noted on the Contract Drawings and special belting is required as identified herein. If conveyor angles are required to be greater than 18 degrees and are not noted on the BHS Contract Drawings as being greater than 18 degrees, the BHSC shall identify the location(s) and inform the Owner or OAR for review of the situation.
 - b. Trackled Zones: For conveyor transporting normal sized or oversized baggage, the maximum angles of inclines and declines shall not exceed 12 degrees from the horizontal in tracking zones, unless noted otherwise on BHS Contract Drawings. In some locations, angles greater than 12 degrees may be required and at these locations, the slope shall not exceed the angle noted on the Contract Drawings and special belting is required as identified herein. If conveyor angles are required to be greater than 12 degrees and are not noted on the BHS Contract Drawings as being greater than 12 degrees, the BHSC shall identify the location(s) and inform the Owner or OAR for review of the situation.
 - c. Spiral Turns (Bag Tracking and Non-Bag Tracking) Angles:
 - 1) For Spiral Turns utilizing Bag Tracking, the elevation change of the spiral turn shall not exceed 24" (600mm) in 90 degrees (4" (100mm) per 15 degrees of rotation), unless noted otherwise on BHS Contract Drawings. If Spiral Turn angles are required to be greater than 24" (600mm) in 90 degrees and are not noted on the BHS Contract Drawings as being greater than 24" (600mm) in 90 degrees, the BHSC shall submit a request for information identifying the location(s) with

detailed drawing information explaining the conditions to the Owner or OAR for review of the situation.

- 2) For Spiral Turns not utilizing Bag Tracking , the elevation change of the spiral turn shall not exceed 30" (760mm) in 90 degrees (5" (125mm) per 15 degrees of rotation), unless noted otherwise on BHS Contract Drawings. If Spiral Turn angles are required to be greater than 30" (760mm) in 90 degrees and are not noted on the BHS Contract Drawings as being greater than 30" (760mm) in 90 degrees, the BHSC shall submit a request for information identifying the location(s) with detailed drawing information explaining the conditions to the Owner or OAR for review of the situation.

6. Conveyor Speeds:

- a. Belt speeds shown on the drawings or schedules are intended to be a general guide for reference. Input conveyor speeds shall be approximately 90 feet per minute (0.46 m/s) and the speed of each downstream section shall be incrementally increased as appropriate for the installation to promote the successful transfer of bags from section to section. The speed of conveyors discharging bags to recirculating devices shall be as recommended by the recirculating device manufacturer. Actual belt speeds shall be determined by the BHSC in accordance with good design practice for airport Baggage Handling Systems (BHS). BHSC shall design the systems to minimize the number of different horsepower ratings and size of reducers to maximize use of spare parts. The change in speed between two conveyor sections is not to exceed 30 feet per minute (0.46 m/s).
 - b. Within the BHS, the conveyors which have frequently start and stop function shall be equipped with Variable Frequency Drives (VFD), external dynamic braking resistor module and heat sink in a remote panel adjacent to conveyor/motor or self-contained decentral drive unit.
 - c. For the purposes of detail design, the belt speed on each conveyor with VFD shall be initially set at least 10% above the proposed field design speed, as per the motor manifest (with VFD setting at 60 Hz).
7. Drive Horsepower: Size conveyor drives so that starts can be made under full load conditions. BHSC shall identify horsepower requirements for each conveyor drive using the requirements identified herein. Estimated horsepower for each conveyor drive is identified in the equipment schedules in the BHS Contract Drawings and shall be used in verifying the actual horsepower requirements for each drive. Requirements for determining the horsepower rating for each drive are listed herein and shall be complied with in the calculations.

8. Quality Requirements:

- a. All materials and components furnished shall be new and free from defects and rust. Used equipment, whether reconditioned or refurbished, shall not be installed for permanent work.
- b. Standardization shall be applied to the greatest extent practicable. Supply equipment of the same type and from the same manufacturer when multiple applications are required.

9. Operating Condition:

- a. Normal operations shall be considered to be 20 hours per day, 365 days per year.
- b. All components shall operate satisfactorily within a temperature range of 20 deg. F to 120 deg. F, with a relative humidity of 0 to 100 percent. In spaces subject to exterior environmental conditions,

all components shall operate satisfactorily within a temperature range of -30 deg. F to 120 deg. F, with a relative humidity of 0 to 100 percent.

10. Maintainability:

- a. Equipment components requiring inspection and servicing shall be readily accessible. Suitable doors or removable enclosures in the building shall be furnished and installed within this contract for this purpose. On the conveyor, access holes in frames or guards are acceptable but shall be held to a minimum number and size and shall not create protrusions or discontinuities detrimental to the baggage being conveyed or produce a safety hazard.
- b. All components and assemblies (i.e., rollers, pulleys, drive units, etc.) shall be designed for easy disconnection and removal from the conveyor system without the necessity for extensive disassembly or repositioning of the conveyor system. Components and assemblies other than power turns, spiral turns, merges, and full conveyor sections shall be designed for removal and replacement by two maintenance workers in a period not to exceed two (2) hours. All components shall allow scheduled routine maintenance to be performed by two maintenance workers in a period not to exceed two (2) hours.
- c. Conveyors shall be designed so that no scheduled preventive maintenance task requires more than two hours of full system or subsystem shutdown, three hours of reduced system operation or any combination of both in excess of three hours. If bearings are not sealed for life, greasing bearings or other similar preventative maintenance tasks shall not require more than 15 minutes, maximum, to access the component.

11. Vibration:

- a. The conveyor equipment shall not produce or induce objectionable vibrations into the building structure. Vibration levels induced by the BHS and its components shall be minimized to the greatest extent possible by installation of vibration isolation devices as identified herein. In no situation shall vibration be injurious to the BHS or the building structure or be harmful or annoying to passengers and employees.
- b. Provide vibration isolation devices or techniques on suspended and floor supported BHS and catwalk to meet this requirement. Devices shall be as specified herein.

12. Seismic:

- a. The BHS equipment and its structural attachments including all connection types shall be designed by the BHSC's structural engineer, who shall be licensed in the location of installation, to meet the seismic requirements at this location. The structural engineer's drawings and comprehensive calculations for all BHS structural components and connection types shall be submitted with 60 calendar days after award of contract for review and approval.
- b. The BHS structural design for BHS mechanical and electrical components shall comply with the general structural notes in Structural Contract Drawings.

13. Noise:

- a. The BHS equipment with bags shall not generate noise which would be annoying or harmful to passengers and/or employees in public and operations areas. Noise requirements defined herein are based upon measurements indicating an ambient noise level of 50 dB in public areas and 60 dB in

non-public areas. The baggage handling system equipment shall not increase the ambient noise level more than 15 dB. The total noise levels shall not exceed 70 dB above the frequency of 4000 CPS or below 100 CPS (a harmonic condition could occur that would result in a cumulative noise level, due to the physical installation of other equipment in the area).

14. Finger guards: Finger guards shall be provided on all conveyors that are in tenant work areas, accessible to tenant personnel; in public areas, and accessible to the public.
15. Skirting: Provide skirting on all load and unload conveyors in all tenant staffed areas and shall cover all rotating components. Provide flared sideguard(s) on adjacent downstream conveyor, as detailed in the BHS drawings. Skirting is not required where guardrail is provided adjacent to the conveyor. In the Checked Baggage Reconciliation Area (CBRA), skirting shall extend down to the floor to keep users / small objects from going under the conveyor, as well as keeping TSO protected from moving parts. If the backside of conveyors is accessible to users in the CBRA, then skirting must also be provided to the floor on the backside of the conveyor.
16. Sideguards:
 - a. The back sideguards at the load conveyor shall be 21" in height.
 - b. All sideguards after the load conveyor shall be 21" in height at the non-catwalk side. All sideguards at the catwalk side shall be 12" in height. All sideguards of the queue belts of the SS-lines shall be 4" in height. All sideguards of the queue belts and transport power turns of the OOG-line shall be 4" in height.
 - c. Flared sideguards shall be provided at the charge-end of the conveyor after each security/fire door and inbound load belt.
 - d. A transitional sideguard shall be provided at every location where there is a change in sideguard height.
17. Catwalks, Ladders and Crossovers:
 - a. Catwalks, ladders, crossovers shall be provided to access all bag jam points, all control station locations, conveyor access point locations, and as required by code to properly access and maintain conveyors. BHS Contract Drawings show required catwalk locations but may not show all necessary catwalk/ladder with self-close swinging gate/crossover. It is the responsibility of the BHSC to design and provide access, catwalks, ladders and crossovers for this function. The BHSC shall provide all necessary catwalks, ladders with self-close swinging gates, steps and crossovers as requested after the BHS has been installed.
 - b. Provide and install catwalks and ladders as shown on the drawings. All apparatus shall conform to OSHA and Local Building Code standards and requirements.
 - c. Catwalk support system shall be integral with the conveyor support system.
 - d. Catwalks shall be parallel to level conveyors. Where conveyor is inclined, catwalks shall be level platforms connected by steps or ship ladders. Each step within the catwalks shall be painted with OSHA safety yellow. Under inclines, catwalks shall extend under conveyors to provide a workspace to service drives.

- e. Provide design and assembly drawings, prepared, signed and sealed by a licensed structural engineer who has a license at the location of installation, for the catwalk/conveyor supporting system and attachments to the building structure.
- f. Ladders shall have a capacity of 300 pounds per rung. The rungs shall be square in shape (cross section) and the foot hold (top surface to each rung) shall have a gripping surface.
- g. Angled ladders shall have handrails. Vertical ladders where taller than 8'-0" shall have cages for the portion above 8'-0" except on a side where access to an adjacent catwalk or platform is required.
- h. Maintenance space for a person to walk (six (6) feet clear) shall be provided above the catwalk surface. Where access is less than six feet, those locations shall be submitted for review and approval. After approval, each low clearance location shall be provided with a low clearance safety warning sign with 'safety colors' and head bump protection (padding). Access points at or more than seven feet above any walkway surface shall supported by additional catwalk, unless noted otherwise or unless access above added catwalk would be less than the clear height restrictions listed above. Access points, bag jam points, control stations, etc. above four (4) feet from walkway shall be accessed by ladder wherever added catwalk is not possible.
- i. Clear access along catwalks shall be provided. Drive units along the catwalk shall not protrude across the catwalk more than 2/3 of its width with a minimum clear access of 24" between drive and other side of catwalk. Drives shall be staggered for access where conveyors are adjacent to each other with catwalk or maintenance access between the conveyors. Any obstructions, other than drive units, along the catwalk shall not restrict clear access more than 1/3 of its width.
- j. Ladders shall be ship ladder type wherever possible. Wherever ship ladders are not possible and vertical ladders are necessary, the locations shall be identified and submitted for review and approval.
- k. Catwalks shall be designed to support catwalk loads along with fire sprinkler head assemblies under catwalk as required by fire code.
- l. Catwalks shall be constructed of galvanized steel bar grating with serrated finish and with a minimum 70% open space except at the drive and high maintenance areas which need to be covered with a sheet of galvanized steel that is free of tripping hazard. Preferred catwalk width shall be 42 inches with a 4 inches kick plate except where adjacent to conveyors. The catwalk live load shall be 55 lbs. per square feet for building load calculations.
- m. Crossover shall be installed before any electrical works.
- n. Header steel connection shall not be placed directly above each crossover.
- o. All header steel beam and hanger connections shall be double nutted with flat washer and lock washer.
- p. All existing header steel and threaded rods, which are located in the new BHS work areas, shall not be reused and shall be replaced for the new BHS work.
- q. Lateral bracings shall be provided throughout the system. The locations of lateral bracing shall be submitted for review and approval. The BHSC's licensed structural engineer shall state that the installed bracing locations have been analyzed and are found to be acceptable to the laterally brace

the system. Lateral bracings shall also be provided when the extra locations are identified by The Authority during the site inspections.

18. Handrails: Handrails shall be in compliance with OSHA requirements and Local Building Code standards. Handrails shall be installed on all platforms and catwalks except where adjacent to conveyors. Handrails shall be constructed from 1-1/2-inch x 1-1/2-inch steel tubing and shall be nominally 42 inches from the catwalk to the top rail with a mid-rail provided at 21 inches above catwalk. Handrail shall be designed to withstand a concentrated load of 250 lbs.
19. Floor Supports: The individual floor-type conveyor support shall be vertically adjustable for leveling the conveyor section. Each leg shall be provided two (2) anchor bolts.
20. Conveyor Openings:
 - a. Where conveyor penetrates the floor or other walking/working surfaces, the gap between the equipment and the edge of the opening shall be secured so that no person or tools can fall through the gap. The materials used to secure the gap shall be easily removable.
21. Gap Pans: Removable gap pan shall be provided between conveyor gaps.
22. Fail-Safe bag hoist
 - a. Retractable hoist reel; Speedaire model 440G06 or approved equal. Cable shall be retractable. Cable shall be 20 ft long, min. and shall have the capacity of 100 lbs or more.
23. Fire Resistance Filler at Fire Doors: Provide fire resistance filler at the locations of Fire Door to seal any openings that allow fire to penetrate.
24. Draft Curtains: Provide draft curtain with each security/fire door.
25. Expansion Joints: Expansion Joints have been placed throughout the existing building and new canopy. The BHSC shall design the BHS to accommodate the building movement at each expansion joint; the design shall not cause any bags to have a jam, mis-tracking, lost-tracking or interruption of BHS operation.
26. All BHS equipment in the public space shall have stainless steel trim/finishes (including the control stations).
27. Outdoor Conveyors: Conveyor bed components, sideguards, floor supports, hangers, ladders, handrail and catwalk shall be hot dip galvanized. All fasteners including washers, lock washers, threaded rod and anchor bolts shall be stainless steel.
28. Quick Disconnect Conveyors: Conveyors adjacent to the EDS units as identified in the Baggage System Contract Drawings as “units with quick disconnects and on casters for easy removal” shall be mounted on casters, so that the conveyors can be easily moved out of place to allow the EDS unit to be removed as required by TSA’s Planning Guidelines and Design Standards.

2.1.E. Electrical Design:

1. System Power Provisions:

a. Base Building Contractor:

- 1) Source for systems: 480 VAC, 3 phase, 60 Hz power will be provided by others within the General Building Contract to each Motor Control Panel (MCP) as shown on the BHS Contract Drawings and/or Electrical Contract Drawings. Amperage requirements vary with each system; refer to the BHS Contract Drawings and/or Electrical Contract Drawings for amperage provisions.
- 2) The Base Building Contractor will provide Distribution Panels/Junction Box as shown on the Electrical Contract Drawing.
- 3) The Base Building Contractor will provide feeder cable from the Distribution Panels/Junction Box to each MCP within BHS.

b. Baggage Handling System (BHS) Contractor:

- 1) The BHSC shall coordinate with the Base Building Contractor for the connection of the feeder from the Distribution Panel/Junction Box to the BHS MCP and for the connection between the BHS MCP to the BHS field devices.
- 2) Beyond each provided feeder, the BHSC shall provide Motor Control Panels, services, feeders, and fused disconnects for branch circuits from each MCP as specified and provide panel boxes, conduits, conductors, transformers, fuses, equipment and materials required to complete the fully functional electrical power distribution for the operation of BHS. Provide 120/240 VAC, single phase and 24 VDC control power required for BHS operation from the 480 VAC power. If additional power is required, the Owner or OAR shall be informed immediately upon discovery.
- 3) The BHSC shall provide NEMA 4X for each enclosure, control station, motor disconnect and junction box for all outdoor conveyors.
- 4) The BHSC shall provide hot dip galvanized Rigid Metal Conduit (RMC) with liquid-tight metallic conduit fittings and Liquid-tight Flexible Metal Conduit (LFMC) with liquid-tight flexible metallic conduit fittings for all outdoor conveyors.
- 5) All provided electrical and control components for all outdoor conveyors shall be rated for outdoor use.
- 6) The BHSC shall coordinate with the Base Building Contractor for the supports of the lighting fixtures (if any) and receptacles (if any) along the BHS catwalk.
- 7) The BHSC shall refer to the Electrical Contract Drawings for the feeders, lighting fixtures and receptacles.
- 8) Each system (e.g. outbound, inbound, oversize, etc.) shall be independent and shall be provided with its own Motor Control Panel(s), unless noted otherwise on the Baggage System Contract Drawings. For Non-Distributed Electrical and Controls, each subsystem shall be independent and shall be provided with its own Motor Control Panel(s), unless noted otherwise on the

Baggage System Contract Drawings. For Distributed Electrical and Controls, subsystems can be combined into the Motor Control Panel(s), provided that redundant feeders from separate sources are installed, unless noted otherwise on the Baggage System Contract Drawings.

- c. **Motors and Efficiency:** All motors shall be of the high-efficiency-low energy type. Motors shall be in accordance with the requirements of the Energy Independent and Security Act (EISA) efficiency standards and shall be NEMA Premium/IE3, unless the condition specifically requires NEMA High Efficiency/IE2 motors. For motors controlled by Variable Frequency Drives (VFD), the motor shall be VFD compatible and its motor insulation system shall be complied with NEMA MG-1 Part 31. Motors shall be listed and labeled by Underwriters Laboratories (UL). Motors shall be by one manufacturer throughout this Work, unless motors are part of a pre-assembled specialty piece of equipment that is purchased as a complete unit, such as Vertical Sorters. Motors for standard conveyors, recirculating devices, etc. are not to be construed as pre-assembled specialty pieces of equipment.
 - 1) The conveyors shall be driven by AC motors or brake motors that comply electrically with NEMA MG1. Motors shall be sized for maximum load and belt speed requirements under continuous operation (minimum size 1.5 HP), and shall be capable of withstanding shock caused by frequent starting and stopping under full load where applicable. If overrun is critical to system control operation, motors shall be equipped with automatically applied brakes to prevent overrun after the motors have been de-energized. All motors shall be provided with overload protection of each leg in the control panel. Bolts for mounting of motors shall be welded to motor mount frame for easy replacement of motors.
 - 2) Motor speed, service and type to meet performance and specification standards.
 - 3) Where baggage tracking is required, motors shall be equipped with automatic brakes to prevent overrun.
- d. **Variable Frequency Drives (VFD):** The BHSC is to provide Variable Frequency Drives (VFD) on all conveyors, diverters, merges, reverse-merges/take-away conveyors at diverter units, queue conveyors, spacing conveyors, on all merge receiving conveyors, and on all conveyors feeding a diverter; motor locations for the vertical merges/sorters, as recommended by the vertical merge/sorter manufacturer; and all EDS conveyors, unless noted otherwise in the Contract Documents. It is the responsibility of the Contractor to coordinate with EDS manufacturer and obtain the most current requirements. Provide VFDs on all equipment where the manufacturer requires or recommends their use. Where an equipment manufacturer requires or recommends use of a VFD, Contractor shall coordinate with equipment manufacturer for VFD operational and location requirements or recommendations. Each VFD shall be mounted at the conveyor/close to the conveyor that it is controlling for distributed controls or in a centralized VFD control panel for centralized controls. VFD location shall not impact the operation or maintenance access. The VFD shall be equipped with external appropriately sized dynamic brake resistors and heat sink. VFD locations shall be submitted for review and acceptance.
- e. **Radio Interference:** BHS equipment provided, or its installation shall not cause interference with communications within the airport or between the airport and aircraft or ground vehicles. BHS electrical and electronic equipment, including interconnecting wires and cables shall be designed to operate without malfunction in the presence of normal electromagnetic emissions generated by other equipment installed or used at the airport. The normal airport environments shall include various electrical motors and controls, power tools (including welders), radar, automotive vehicles, communications equipment, etc. Provide isolation transformers and line suppression, if required.

- f. The BHSC shall submit a summary of power load requirements for each system to the Owner or OAR to verify the feeder size. Refer to submittal requirements.
- g. No splices or joints shall be allowed in either feeders or branches except at outlets or accessible terminal, splice or junction boxes.
- h. Wires and cables which have been manufactured more than two (2) years prior to installation shall not be used in this BHS Work.
- i. Tapes for splices or terminations shall be dated by the tape manufacturer to indicate that they have been manufactured no longer than six (6) months prior to use in this BHS Work.
- j. All conduit runs shall contain an insulated ground wire, sized in accordance with NEC.
- k. All wiring for power and control shall be in conduit. Conduits, located at any locations subject to physical damage, shall be galvanized rigid steel conduit.
- l. All outdoor, exposed conduits shall be rigid galvanized steel.
- m. PVC conduits shall not be used.
- n. All conduits (in public and finished areas) shall be concealed.
- o. All wires shall be identified in all cabinets, boxes, other enclosures, and at all terminal points.
- p. For areas designated for demolition, all electrical devices and associated conduits and wirings shall be removed back to the overcurrent device serving the demolished circuit.
- q. Electrical panels and/or enclosure, junction boxes, pull boxes, control stations, motors and other equipment shall be grounded utilizing an insulated ground wire. All clamps, connectors and other hardware used with the grounding system shall be made of copper.
- r. Whenever a grounding conductor is required (including feeders to motor loads greater than 1/8 HP), a separate ground wire shall be installed.
- s. Identification:
 - 1) All parts of BHS electrical and control equipment, including, but not limited to: MCPs, VFD enclosures, motors, motor disconnects, VFDs, warning beacons, photoeyes, shaft encoders, limit switches, OITs, control stations, pushbuttons, MCP disconnects, transformers, replays, motor starters, fuses, PLCs, I/O modules, switches, lights, receptacles, 24VDC power supplies, circuit breaker, and all electrical and control components inside and outside of the MCPs, shall be identified by name, function or control with white phenolic label with black letters machine engraved on the face. Nameplates shall not be smaller than one half (1/2) inch by two (2) inches with characters not less than one-quarter (1/4) inch; securely attached with rivets or stainless steel screws. Use one (1) inch high letters for MCP and VFD enclosures and one-quarter (1/4) inch high elsewhere. Nomenclature shall be approved by the Owner or OAR.
 - 2) All device plates shall have black or white silk-screened lettering Helvetica Medium type face designating: system, voltage, number of phases, current rating and frequency, where applicable.
 - 3) Each control station shall list all conveyors which are in control.

- 4) The outside and inside of the covers of all junction or pull boxes shall be labeled with an indelible marker indicating the operating voltage and system contained in this work.
 - t. Terminal block housings shall be molded from flame-retardant Lexan, Nylon or Polypropylene and terminal block accessories shall be made of flame-retardant materials. All terminal blocks shall be barrier type. At least 20% uniformly distributed spare terminals shall be provided.
 - u. Expansion Joints: The BHSC shall design the electrical and control BHS components and equipment including conduits to accommodate the building movement at each expansion joint according to the NEC or local electrical code requirements, whichever is more stringent; the design shall not cause any breakages/damages of the electrical and control BHS components and equipment or interruption of the BHS operations.
 - v. Additional Lighting: The GC shall provide general lighting for the new building. The BHSC shall coordinate with GC for the additional lighting where the areas have been covered or blocked by BHS equipment in the new building. After the installation of BHS has been completed, the BHSC shall walk through the BHS with the Owner or OAR to determine the locations where the Authority requires additional lighting. The GC shall provide the additional lighting fixtures and wire to the nearest Base Building contract light fixture according to the NEC or local electrical code requirements, whichever is more stringent. Refer to the electrical specification for lighting requirements.
 - w. Device Layout: The device layouts in the BHS Contract Drawing shall not be changed after the contract award unless it is acceptable to the Owner or OAR.
 - x. Construction Phasing: Several construction phases shall be required for completing the new BHS. The BHSC shall coordinate with the Owner or OAR for construction phasing.
2. Baggage Control Systems:
- a. Supervisory High Level Control (HLC) System and Low Level (PLC) Control (LLC) System: The automated sortation baggage control system shall utilize an integrated network of redundant Supervisory High Level Control System consisting of servers, switches, and network equipment and interfaces, and Low Level Control System consisting of programmable logic controllers (PLCs) and other equipment specified herein to properly distribute baggage to CBRA and the make-up device and monitor system faults. The controls shall be designed to meet the specific functional requirements of the baggage system for sortation, status, and maintenance information. The PLC and Supervisory Control System network shall function as an integrated system each performing a portion of the operational requirements. The Supervisory Control System shall obtain status information from the PLCs and update the SCS workstations and display monitors. The Supervisory Control System shall have the ability to test the fire alarm and Access Control interface functions. At a minimum, the system shall consist of the following:
 - 1) Sortation Allocation Controller (SAC),
 - 2) Sortation Controller (SC),
 - 3) Maintenance Diagnostic System (MDS)-SCADA,
 - 4) Maintenance Management Information System (MMIS),
 - 5) Maintenance Information System (MIS).

- 6) System shall consist of redundant servers for sortation control of bags, fault and maintenance monitoring, and reporting. Two fully redundant servers with automatic and manual switch over control shall be provided for SAC and MDS processing. Provide high availability virtualization technology software synchronizing two standard windows servers to create a single windows application environment to achieve hot-backup redundancy with automatic and transparent switchover. This virtual server shall look and act like any other server and shall have the resiliency of two physical servers providing redundancy. Each server shall receive and process the same information and act as a backup for the other server. One of the servers shall be in the primary and control mode, while the other server shall be in “hot backup” mode and serve as backup for the primary server. If the primary faults, the switch over of the “hot backup” shall be immediate and shall contain all of the data. Both servers shall be identical and sized to provide all functions necessary for processing without diminishing the rates and capacities identified herein. All database information must be protected against any single point of failure, so that both servers have full access to all of the data in the event that one server fails. In the event of any failure that requires the switch over of the “hot backup” server to the primary server, the switch over shall be identified on the monitors and kept in the fault data file for report printing and archival. Servers shall be networked using TCP/IP protocols over an Ethernet network and equipped with keyboards, graphics monitors, printers, and peripherals as identified herein or as necessary for a complete operational system. Servers shall produce unique baggage IDs and track the bags through the security screening process. In addition to sortation functions, the SAC shall keep track of the unique bag identifier and the status of the bag processed through the EDS unit in a database for use in tracking and verification. MDS shall display all system faults and status utilizing color monitors for status display. Fault monitoring alarms shall include, but are not limited to: bag jams, E-Stops, circuit breaker trips, and motor overload trips conditions. The monitors shall display system status of all conveyor lines being monitored. All bag jam, E Stop, overload, and circuit breaker trip conditions shall be displayed in the appropriate colors; along with other pertinent information displayed in contrasting colors as identified under “System Status Indicators” herein. Graphic software requirements for fault and maintenance display are stated in this Specification Section. MDS shall keep track of hours of system operation and quantity of bags processed through the system. A separate audible alarm with alarm silence pushbutton shall be provided for bag jam and E stop conditions at the control station in the Supervisory Control System monitoring workstation to alert operator(s) of system faults. A report of all faults shall be echoed to a file for archival and printing upon demand. Provide storage capacity for archiving these “system fault” files daily for a period of 6 months. File shall be automatically named with date as part of the name and stored in storage prior to daily reboot as identified above. Laser printers shall be connected to the servers for print out of reports upon demand. Refer to submittal requirements stated herein for submission requirements on report formats. Servers, cooling fans, and field wiring termination points shall be contained in standard size vertical rack systems located at location(s) as required. Enclosure(s) for servers and associated equipment shall be equipped with heat sensor and alarm to provide warning of any high temperature conditions within the enclosure(s) that would be harmful to the electronic equipment. Additional equipment requirements are defined herein.
- 7) Programmable Logic Controllers (PLCs): Each baggage system shall utilize one or more programmable logic controllers (PLC) as the logic control of the system with remote I/O in the subsystem motor control panels. The baggage system logic controller shall accept all external inputs from pushbuttons, switches, and photocells, and act as the logic unit to control all conveyor functions and operations as specified in this Specification Section, as indicated on the drawings, and as required for a complete operating system. The logic controller shall interface with the SAC and MDS servers identified herein. The PLCs shall be installed in Control Panels to be located in the baggage control room with remote I/O bases installed in the Motor Control

Panels (MCP) of the baggage subsystems, as indicated on the drawings. All PLCs shall be networked to the Supervisory Controls via manufacturer's standard data communications link, Ethernet, or approved equal data communications link protocol. Refer to Contract Drawings for network system topology. Each PLC (Primary) in the baggage control room shall have an identical redundant PLC (Backup) and both PLCs shall receive, process, and send the same data. Output from the Primary PLC shall be used for the operation of the associated baggage system; unless the Primary PLC faults in which case the Backup PLC output shall immediately be used for the operation of the associated baggage system. Additional equipment requirements are defined herein. The PLC program shall control all operation functions, unless specified otherwise. Power to inputs and outputs that must remain operational during shut down due to E-Stop activation, circuit breaker trip, overload trip, etc. shall not be interrupted or disconnected by the associated occurrence, unless necessary for safety. For example, E-Stop activation shall not disconnect power to inputs and outputs controlling security door operations on the system so that the door may close to secure the opening, unless the E-Stop activated is adjacent to the security door and the door should not close.

- 8) Redundancy: All sortation controller and fault monitoring computers/processors, peripherals, and transmission equipment within the baggage control system pertaining to safety or providing system operation and PLCs shall have redundant elements to keep the system operating in the event of component failure in the control system. Provide automatic online self-checking diagnostic features for detection of a failure or loss of any function. In the event of any failure that requires the switch over of the "hot backup" computer to the primary computer shall be identified on the monitors and kept in the fault data file for printing and archival. Equipment and components downstream of the PLCs are not required to be redundant, unless noted otherwise or necessary for the operation.
- 9) Virtual Private Network (VPN): Provide a redundant, remote access to the HLC and LLC using VPN technology with firewall and intrusion detection systems for program updates, any necessary trouble shootings or reprogramming from remote locations. The BHSC shall provide a year internet access service for the connection. After that, the BHS Operation and Maintenance team shall continue to provide this internet access for the connection.
- 10) SCS Workstation: Provide a workstation consisting of a CPU that is networked to the servers, two 24" monitors as identified below, keyboard, and mouse for display of SAC, MDS, and reports software and data.
- 11) System Printers: Computer systems shall be networked to laser printers. Reports shall be sent to the assigned printer(s) upon demand. Provide a BHS SCS printer to print all BHS reports and data from SAC and MDS programs.
- 12) Monitors: Contractor shall provide graphic screen monitors capable of accurately and clearly displaying the entire baggage system graphic, software program displays, or report information for which the monitor is intended. Quantities of monitors and display of systems, at a minimum, shall be as follows:
 - a) Provide two 24" graphic monitors as part of each SCS workstation for SAC, MDS, and Report display at location shown on the Baggage System Contract Drawings.
 - b) Provide one wall mounted 42" graphic monitor in the Baggage Control room for system status display at location shown on the Baggage System Contract Drawings.

- c) Provide one wall mounted 42" graphic monitor in the CBIS/CBRA room for system status display at location shown on the Baggage System Contract Drawings.
 - d) Provide one wall mounted 42" graphic monitor in the OSARP (OSR) room for system status display at location shown on the Baggage System Contract Drawings.
- 13) Software and Programming: Contractor shall provide software and hardware consistent with industry standards, and where necessary, compatible with airport's equipment. Software and programming shall be provided for proper sortation of baggage, for graphical display of system faults and maintenance information pertaining to the operational status of the conveyor system as detected by the PLCs and computers, interfaces with other systems, and all other necessary computer programs for a complete operating system as required herein. All text used to describe or report problems shall match the descriptions used on the final engineering and record drawings. Contractor shall, at a minimum, adhere to the software architecture listed below and provide all associated hardware to accomplish the required functions of the Baggage System.
- a) Operating System (OS) shall be Windows Server 2008R2 64-bit network operating system and Windows 10 Ultimate 64-bit for all workstation PCs or approved equal. It shall comply with the requirements identified herein and on the Contract Drawings.
 - b) Networking and Communications shall be Fast and Gigabit Ethernet Cat 6 protocols. It shall comply with the requirements identified herein and on the Contract Drawings.
- 14) Software Documentation: Provide latest commercially available nonproprietary software wherever possible and applicable, unless application requires customized programming. Beta software is not acceptable. All software proprietary information shall be provided to the Owner prior to Final Acceptance, but shall not indemnify the Baggage System Contractor for technical defects that occur with the software. Program source codes with Non-Disclosure Agreement and software licenses for this Work shall be owned by the Owner. If a Non-Disclosure Agreement is not acceptable, then proprietary program source codes shall be placed in escrow for the Owner's access.
- a) Documentation of commercially available software used in the system shall include all available information from the supplier of such software; all programmer and user manuals; and other similar material along with a complete listing of all software programs. Refer to submittal requirements.
 - b) All data, software, related documentation of any form of writing, figures, or delineations, which are created for the Work that are not commercially available shall be provided to the Owner. Documentation on software unique to the system, not commercially available, shall include functional, performance, and interface requirements; descriptions of the supervisory, control, and operating software; configuration control documentation; flow charts; source listings; and programmer and user manuals incorporating appropriate modification and control procedures. Refer to submittal requirements.
- 15) Uninterruptible and Conditioned Power: Provide UPS and conditioned power regulation for the Supervisory Control System, computers and network equipment in the baggage control room.
- 16) Casework: Provide a workstation desktop as specified in specification section 125110 at location shown on the Baggage System Contract Drawings to support the SCS Workstation.

Desk shall meet the requirements of TSA's Planning Guidelines and Design Standards for Checked Baggage Inspection Systems version 4.1 for ergonomics. Provide vertical rack enclosure at location shown on the Baggage System Contract Drawings to support the servers, computers, switches, network equipment, etc. as specified herein.

3. Interfaces:

a. ATR Interface:

- 1) The system shall support the standard signal and communications interface with the ATRs/OCRs for the purpose of obtaining baggage information and device status. OCR's will be used to enable obtaining and reconstructing information which will allow remote manual coding to be performed. It is a requirement to supply remote diagnosis software along with a main 'Sentry' device to enable maintenance, diagnosis and relevant information to be supplied to the high-level control systems.
- 2) The system shall be compatible with all the latest industry standards and IATA recommended Practice. Identification of all bags; checked-in, transfer, off airport checked-in and others, shall be based on reading of the bar code printed on bag tags in accordance with the latest edition of IATA resolution 740 and the latest edition of IATA Recommended Practice 1740b (License Plate Fallback Sortation Tag).
- 3) Additional interface requirements are identified herein.

b. Baggage Information Message/Baggage Source Message (BIM/BSM) Interface:

- 1) During baggage check-in, the BHS shall interface with airlines departure control systems (DCS) through the Message Broker System (MBS) to obtain the baggage source messages (BSM). The BHS processes the BSMs, which are used to identify, route and track the bags all the way to their intended destination. The sortation allocation computer (SAC) and control system of the BHS shall match the license plate obtained by the baggage identification system with the identical number on the BSM generated and transmitted in accordance with the applicable parts of the latest edition of IATA Recommended Practice 1745.
- 2) The BHS shall be capable of sending Baggage Processed Message (BPM) and Baggage Unload Message (BUM) through this interface.
- 3) Connections to the Message Broker System (MBS) (to receive BSMs and send BPMs, receive flight information, receive make-up allocation information, send at least status information of the availability of make-up units and EBS).
- 4) Additional interface requirements are identified herein.

c. Closed Circuit Television (CCTV) Interface:

- 1) The CCTV for the BHS / TSA shall be have its own CCTV system for its operation, but it shall also interface with the CCTV system of the Terminal Building. BHS shall coordinate information to be provided with the OAR.

- d. Departure Control System/Local Departure Control System (DCS/LDCS) Interface:
 - 1) The BHS shall interface with airlines departure control systems (DCS) through the Message Broker System (MBS) to obtain the baggage source messages (BSM). The BHS processes the BSMs, which are used to identify, route and track the bags all the way to their intended destination. The sortation allocation computer (SAC) and control system of the BHS shall match the license plate obtained by the baggage identification system with the identical number on the BSM generated and transmitted in accordance with the applicable parts of the latest edition of IATA Recommended Practice 1745.
 - 2) The BHS shall be capable of sending Baggage Processed Message (BPM) and Baggage Unload Message (BUM) through this interface.
- e. Explosive Detection System (EDS) Interface:
 - 1) The BHS shall interface with the EDS equipment and CBIS security network and provide complete in-line CBIS system for all check-in standard bags, check-in oversize bags, check-in non-conveyable bags, transfer standard bags, transfer oversize bags and transfer non-conveyable bags.
 - 2) The BHS contractor is responsible for coordinating with the EDS manufacturer and supply any hardware and software required to integrate the EDS machines with the BHS in accordance with the manufacturer's Integration guide. The BHS shall support the standard signal and communications interface with the EDS machine for the purpose of baggage flow control, machine status, and bag identification and security decision notification.
 - 3) Interface between EDS equipment and BHS equipment shall be in compliance with EDS vendor's Interface Requirements and TSA's Interface Requirements Document (IRD), latest version.
 - 4) Additional interface requirements are identified herein.
- f. Fire Alarm/Detection System (FADS) Interface:
 - 1) Provide wiring, contacts, circuitry, and programming to stop the BHS in a control fashion upon direction from the Fire Alarm/Detection System. See "Descriptions of Operations" for control sequences. Coordinate with Fire Alarm/Detection System for interface programming and connection requirements.
 - 2) The BHSC shall coordinate with the GC and/or FADS Contractor for the interface between BHS and FADS.
 - 3) The GC and/or FADS Contractor will provide an interface box with a dry contact closure, wiring and conduits within five (5) feet from each MCP which controls a fire door.
 - 4) The BHSC shall provide wiring and conduit from the interface box to the associated MCP and to the associated door controller. The BHSC shall terminate the wiring in the interface box with the assistance of FADS Contractor and shall terminate the wiring in the MCP and in the door controller.
 - 5) The BHSC shall ensure that when a signal is sent to the dry contact from the FADS, that the conveyor line shall shut down appropriately.

- 6) The interface of the BHS to the FADS will be one (1) dry contact closure per MCP which controls the fire doors. Refer to the FADS drawings for the location of this contact.
 - 7) Additional interface requirements are identified herein.
 - g. FIDS/BIDS Interface: NA
 - h. Access Control System (ACS) Interface:
 - 1) Outbound Baggage Systems: A security access card reader/key pad will be furnished and installed by the Access Control System Contractor, at each START control station indicated on the baggage system drawings. The card reader/key pad(s) shall enable the START pushbuttons along the load conveyor in the input area. The baggage system or subsystem associated with that security station shall not be activated until the card reader/key pad has been accessed and approved. When access is approved, the system shall be started by pressing the START pushbutton. If security system is not functioning, a jumper in the MCP shall be provided for operation during ACS down time only. Jumper shall not be operational when ACS is operational. Dry contacts shall be furnished and installed in a junction box at location(s) indicated on the baggage system and security system drawings, for interface with the security system. Provide contacts, circuitry, and programming as specified herein or shown on the drawings for Access Control system start up approval, shut down, and security door status. The security door status interface shall be set up to identify when each security door is in its open position while the baggage system is in operation, when each security door is in the closed position and the baggage system is deactivated, when each security door is open but the baggage system is not in operation, and when there is a fault condition with each security door and it is not operating properly. At a minimum, fault conditions of each door and the door open/system deactivated condition shall be sent to the security system for monitoring. Coordinate with Access Control System for interface programming and connection requirements.
 - 2) Inbound Baggage Systems: NA
4. Baggage Information Messages:
- a. Contractor shall provide connection from redundant BSM servers provided in the BIM service provider in a separate Contract, located on-site, to Sortation Controller servers for BSM Data/ATR Data comparison.
 - b. Baggage Source Message (BSM) Interface: Contractor shall provide a data connection from redundant BSM servers, located on-site, to Sortation Controller Computers for BSM Data/ATR Data comparison. Redundant BSM servers will be provided by an approved vendor as part of the BIM Service Provider contract. BHS Sortation Controller Servers shall receive and accept full Baggage Source Messages as provided from the Airline Host computers and shall parse out unneeded information, as determined by the users, and delete messages from airlines that are not part of this baggage sortation system. Baggage Source Messages shall be received from both BSM servers to both Sortation Controller Computers. One BSM server and one Sortation Controller Computer shall be designated as primary with the others as hot backups. Crossover box can be used to send messages from either BSM server to either Sortation Controller Computer. RS 232, 4800 baud, Even Parity, 7 data bits, 1 stop bit, or other acceptable data transfer protocol shall be used for the interface connection. Refer to IATA Recommended Practice 1745 "Baggage Services Messages" and IATA Recommended Practice 1797b "Baggage System Interface" for BSM requirements.

- c. BHS Sortation Controller Computers shall receive and accept full Baggage Source Messages as provided from the Airline Host computers. Sortation system shall be capable of receiving and reacting to all standard messages, which include BTM, BSM, BPM, BUM, BNS, and BCM. System shall process BSMCHG and BSMDEL messages. BSM data and format type shall be Version 1. Sortation Controller Computers shall delete unwanted information, as determined by the Port and users, and delete messages from airlines that are not part of this baggage sortation system.
 - d. Redundant BSM servers will be provided by an approved vender as part of the BIM Service Provider contract.
 - e. All data elements and fields of the BSMs shall be retained in a BSM database for sortation and report generation. BSMs shall be time stamped at time of receipt and stored in the database. BSM database shall have the ability to record receiving duplicate BSMs and report the frequency of duplicates upon demand from the user. Duration of retained data shall be three days or as determined by the Owner. The Owner's Baggage Operations authorized personnel shall control deletion of data, either manually or automatically.
 - f. Baggage Source Messages shall be received from both BSM servers to both Sortation Controller Computers. If one of the redundant BSM servers is not functioning, data from the other BSM server shall be sent to both Sortation Controller Computers.
 - g. Contractor shall make all necessary connections to the BSM servers. TCP/IP Ethernet protocols shall be used for the BSM interface connection. Redundant switches shall be provided (each connected to the redundant sort computers) with 2 CAT 6E cables (1 spare) connected to each switch and routed through two separate conduits to the nearest communication room. Conduits are installed with pull wire. Contractor shall coordinate connections with BSM server provider.
 - h. Supervisory Computer System shall have capacity for storing a minimum of 1,000,000 BSMs. BSMs that are processed shall be held for 24 hours and then automatically deleted. BSMs that are not processed shall be held for 72 hours and then automatically deleted.
 - i. Refer to IATA Recommended Practice 1745 "Baggage Services Messages" and IATA Recommended Practice 1797b "Baggage System Interface" for BSM requirements.
 - j. System shall be capable of processing any of the mandatory (M), conditional (C), and optional (O) BSM elements/fields listed in IATA Recommended Practice 1745 "Baggage Services Messages" for proper baggage sortation.
 - k. Baggage Process Messages (BPM) shall be sent out at strategic locations in the system to identify processes completed.
5. Monitoring Display Systems (MDS):
- a. Fault monitoring computers shall provide system status information for the associated system. Fault monitoring computer shall keep track of hours of system operation and quantity of bags processed through the system. Fault monitoring computer shall graphically display the baggage system or subsystem(s) layout associated with the motor control panel and each section of conveyor or device on the system layout shall show a color fill that is representative of the current status as follows:
 - 1) Green fill for conveyor on and running.
 - 2) Gray fill for conveyor on and stopped.

- 3) Red fill for conveyor stopped due to E Stop.
 - 4) Yellow fill for conveyor stopped due to bag jam condition.
 - 5) Blue fill for conveyor stopped due to motor overload.
 - 6) Cyan fill for conveyors stopped due to circuit breaker trip.
 - 7) Magenta fill for conveyor stopped due to flow control.
- b. In addition to the graphic baggage system layout status fill colors on the fault monitoring computer system, provide status indication symbols on the system layout display screens for the following conditions:
- 1) Green indicator (one per system controlled) - indicates "run" condition. Locate on bottom of all graphical display screens.
 - 2) Red indicator (one per E STOP push button) - indicates location at which an E STOP push button has been activated. Locate one symbol at each E STOP location and turn symbol red only at activated E STOP.
 - 3) Yellow indicator (one per bag jam photosensor) - indicates location at which a bag jam has occurred. Locate one symbol at each bag jam photosensor location and turn symbol yellow only at bag jam occurrence.
 - 4) White indicator (one per tall bag photosensor) - indicates location at which a tall bag jam has occurred. Locate one symbol at each tall bag photosensor location and turn symbol white only at tall bag jam occurrence.
 - 5) Blue indicator (one per motor) - indicates motor overload trip condition. Locate one symbol at each motor location and turn symbol blue only at overload tripped motor.
 - 6) Cyan indicator (one per motor control panel) - indicates motor circuit breaker trip condition. Locate one symbol at each system controlled from a motor control panel location and turn symbol cyan only at circuit breaker tripped system.
 - 7) Orange indicator (one per system controlled) - indicates fire detection system activation. Locate on bottom of all graphical display screens.
6. Maintenance Management Information Systems:
- a. Provide applications on the Supervisory Control System to gather statistical information and generate reports on information necessary for the successful operation of the baggage system. Peripherals of the Supervisory Control System shall be used for the generation of reports. Three levels of usernames and passwords shall protect access to the system. Level 1 shall be for operators, level 2 shall be for supervisors, and level 3 shall be for personnel requiring access to programming and report modifications. Levels 2 and 3 shall be capable of resetting counters and statistics. Reports and statistics shall be, at a minimum, as identified herein. Provide draft copies of the reports to the Owner for review and acceptance prior to programming the system. The Airlines or users may require additional reports. Contractor shall request additional report requirements prior to the programming of the system.

- 1) Tag Reports: Print out of all bag tags during the operational period. Shall be capable of being sorted in ascending or descending order by tag number, flight number, and alphabetical passenger name. Report shall have the ability to search for any text in any field. Every occurrence of a bag tag being read shall be shown. Display and print out of the report shall be provided upon demand.
- 2) Sort Correlation Table: Print out of the entire flight record database. Shall be capable of being sorted in ascending or descending order by flight number, destination, closeout time, departure time, make-up units. Report shall have the ability to search for any text in any field. Level 3 protection for disregarding a single flight, all flight closeout times, and all flight departure times shall be provided. Disregarding of any information shall be identified on the report. Display and print out of the report shall be provided upon demand.
- 3) Immediate Equipment Malfunction Report: Display and print out report of immediate equipment malfunctions upon demand. Report shall be generated for the following equipment failures:
 - a) I/O Fault
 - b) DCH Failure
 - c) Diverter Failure
 - d) Motor Failure
 - e) Photoeye Jam
 - f) Tachometer Failure
 - g) MCP/Field Device Failure
 - h) Door Fault
 - i) E-Stop
 - j) Over length
 - k) Over height
 - l) Conveyor Full
 - m) Missing Bag Jam
 - n) Laser Array Failure
 - o) Unknown Bags
 - p) Motor Overload
 - q) Circuit Breaker Trip
 - r) Pier Failure

- s) PLC Failure
 - t) Computer to computer communication lines not linked.
 - u) Host computer comm. lines not linked.
- 4) Immediate Equipment Correction Report: Display and print out report of equipment corrections for any equipment failures reported in the immediate equipment malfunction report upon demand.
 - 5) Equipment Operational Summary: Print out and display upon demand, by subsystem, of pusher, photocell, and sorter statistics and summary of individual device malfunctions identified in the immediate equipment malfunction and correction reports.
 - 6) Computer and PLC Status Report: Print out and display upon demand of computer and PLC online/offline information and status. PLC information shall be dynamically retrieved from the PLC Data tables.
 - 7) Equipment Malfunction Summary: Print out and display upon demand, by subsystem, of a summary of the immediate equipment malfunction and correction reports.
 - 8) Load Balancing Report: Print out and display upon demand of individual subsystem loading for the operational period. Time interval for current throughput figures shall be selectable from 1 minute to 24 hours. Shall report on, at a minimum, the following subsystems.
 - a) Ticket Counter Inputs
 - b) Curbside Inputs – Alternate 1
 - c) Transfer Inputs - NA
 - d) Pre-EDS Main Lines
 - e) Post-EDS Main Lines
 - f) Manual Encoding Lines - NA
 - g) Bag Security Lines - NA
 - h) Feeder/Make-up Subsystems
 - 9) Runout Report: Print out and display upon demand of default make-up unit statistics for each subsystem. Time interval for current throughput figures shall be selectable from 1 minute to 24 hours.
 - 10) Laser Array Report: Print out and display upon demand of all laser array head statistics for each array.
 - 11) Day End Report: Print out and display an end of operational period report of throughputs, laser statistics, and outputs. Report printing shall be upon demand and at selectable intervals to be set up by the user.

- 12) Sort Area Assignment Report: - NA
- 13) Flight Summary Report: Print out and display an end of operational period report of flight summary as reported by the scanner array on each mainline. Bags on time and bags late shall be selectable from departure time. Report printing shall be upon demand and at selectable intervals to be set up by the user.
- 14) Bag Tag Not Found Report: Print out and display upon demand of all bag tags read with no destination shall be displayed in this report. Shall be capable of being sorted in ascending or descending order by tag number, flight number, alphabetical passenger name. Report shall have the ability to search for any text in any field. All bags read by the scanners shall be verified for proper destination. In the event that a bag does not have a proper destination, the bag tag shall be recorded in the report.
- 15) BSM Report: Print out and display upon demand of all bag tags during the operational period. Shall be capable of being sorted in ascending or descending order by tag number, flight number, alphabetical passenger name. Report shall have the ability to search for any text in any field. Every occurrence of a bag tag being read shall be shown. "Time" shall indicate the time that the bag tag was read. "Print" indicates time bag tag was printed. "BSM REC'D" indicates time the BSM was received at the BHS from BSM link.
- 16) Daily CBIS Summary Report: Print out to BHS CBRA printer a daily CBIS summary report upon demand and at selectable intervals to be set up by the user. This report is to be identified as Security Sensitive Information (SSI) and is only to be sent to the BHS CBRA printer for TSA's review. These generated reports are not to be stored or archived.
- 17) Daily CBIS Bag Volume Report: Print out to BHS CBRA printer a daily CBIS bag volume report upon demand and at selectable intervals to be set up by the user. This report is to be identified as Security Sensitive Information (SSI) and is only to be sent to the BHS CBRA printer for TSA's review. These generated reports are not to be stored or archived.
- 18) CBIS Executive Summary Report: Print out to BHS CBRA printer a CBIS executive summary report upon demand and at selectable intervals to be set up by the user. This report is to be identified as Security Sensitive Information (SSI) and is only to be sent to the BHS CBRA printer for TSA's review. These generated reports are not to be stored or archived.
- 19) CBIS Photoelectric Cell Tracking Report: Print out to BHS CBRA printer a CBIS photoelectric cell tracking report upon demand and at selectable intervals to be set up by the user. This report is to be identified as Security Sensitive Information (SSI) and is only to be sent to the BHS CBRA printer for TSA's review. These generated reports are not to be stored or archived.

7. Flight Schedule Information:

- a. Flight schedules shall be reloaded each day to the SCS Sortation Computers at a configurable time and the SCS Sortation Computer shall be able to handle reloading seasonal, quarterly, and daily schedules. Flight schedule updating shall support MS Excel CSV File format as well as other formats. Flight schedules for the SCS Sortation computers shall contain, but is not limited to, the following categories:
 - 1) Carrier: Two character carrier code.
 - 2) Flight: Four digit flight number.

- 3) City: Three character IATA city code.
 - 4) Open Time: Shall be configurable for each flight.
 - 5) Close Out Time: Shall be configurable for each carrier and for domestic and international flights.
 - 6) Departure Time: Shall be configurable for each flight.
 - 7) Bag Status: The status of bags as relates to being On-Time, Late, or Missed.
8. Motor Control Panels:
- a. Control panels shall consist of floor mounted code gauge sheet steel painted enclosures with hinged doors with key locks. A main disconnect switch or circuit breaker shall be provided inside housing with operating handle arranged to open or close with doors of control panels in closed position. Each starter and each control device shall be provided with a nameplate for maintenance purposes. All transformers shall be installed at the exterior of each MCP. Each MCP shall have a set of audible and visual (Red & Amber) beacon. The power for the control system shall be 120 VAC and/or 24 VDC.
 - 1) Each MCP shall contain at least 25% additional space for future components.
 - 2) Each MCP and other enclosures shall have integral ground buses connected to the ground grid.
 - 3) Each MCP shall include a red startup visual beacon, an amber fault visual beacon and an audible alarm on top of the unit.
 - 4) System Status Indicators:
 - a) Each motor control panel face shall include the following pushbuttons, key switches, and LED indicator lights for the following conditions:
 - (1) Illuminated maintained contact push/pull mushroom head Emergency Stop pushbuttons shall be Red.
 - (2) "Power On" pushbutton shall be Green.
 - (3) "Power Off" pushbutton shall be Red.
 - (4) "Lamp Test" pushbutton shall be Black.
 - (5) Green indicator (one per system controlled) - indicates "Control Power On".
 - (6) Red indicator (one per motor control panel) - indicates E STOP pushbutton has been activated.
 - (7) Amber indicator (one per motor control panel) - indicates bag jam condition.
 - (8) Blue indicator (one per motor control panel) - indicates motor overload trip condition.

- (9) Amber indicator (one per motor control panel) - indicates motor circuit breaker trip condition.
 - (10) Orange indicator (one per motor control panel) - indicates fire detection system interface activation.
 - (11) Amber indicator (one per motor control panel) - indicates baggage system activation enabling via interface with Access Control system.
 - (12) Amber indicator (one per motor control panel) - indicates “Hand” and/or “Off” condition for any “Hand-Off-Auto” in the subsystem.
- b) Motor control panel faces shall be provided with a message display indicating fault conditions.
 - c) Motor control panel faces shall be provided with an 18” (minimum) square static system map indicating the system configuration, showing the controls locations, and screened facility layout. Map shall be acceptable to the Owner. Locate on panel face as shown on the Baggage System Drawings.
- 5) Operator Interface Terminal (OIT):
- a) Each MCP shall be provided with an Operator Interface Terminal (OIT) display indicating the system configuration and providing maintenance operation controls. OIT units shall provide system status information for the associated system. This same information shall be provided on the MDS/SCADA specified herein, if applicable. The locations of BHS component graphics such as control station, photoelectric sensor and MCP shall match the BHS components in the field. OIT and MDS, if applicable, shall keep track of hours of system operation and quantity of bags processed through the system. OIT shall graphically display the baggage system or subsystem(s) layout associated with the motor control panel and each section of conveyor or device on the system layout shall show a color fill that is representative of the current status as follows:
 - (1) Green fill for conveyor on and running.
 - (2) Gray fill for conveyor on and stopped.
 - (3) Red fill for conveyor stopped due to E Stop.
 - (4) Yellow fill for conveyor stopped due to bag jam condition.
 - (5) Blue fill for conveyor stopped due to motor overload.
 - (6) Cyan fill for conveyors stopped due to circuit breaker trip.
 - (7) Magenta fill for conveyor stopped due to flow control.
 - b) In addition to the graphic baggage system layout status fill colors on the fault monitoring computer system, provide status indication symbols on the system layout display screens for the following conditions:

- (1) Green indicator (one per system controlled) - indicates "run" condition. Locate on bottom of all graphical display screens.
- (2) Red indicator (one per E STOP push button) - indicates location at which an E STOP push button has been activated. Locate one symbol at each E STOP location and turn symbol red only at activated E STOP.
- (3) Yellow indicator (one per bag jam photosensor) - indicates location at which a bag jam has occurred. Locate one symbol at each bag jam photosensor location and turn symbol yellow only at bag jam occurrence.
- (4) White indicator (one per tall bag photosensor) - indicates location at which a tall bag jam has occurred. Locate one symbol at each tall bag photosensor location and turn symbol white only at tall bag jam occurrence.
- (5) Blue indicator (one per motor) - indicates motor overload trip condition. Locate one symbol at each motor location and turn symbol blue only at overload tripped motor.
- (6) Cyan indicator (one per motor control panel) - indicates motor circuit breaker trip condition. Locate one symbol at each system controlled from a motor control panel location and turn symbol cyan only at circuit breaker tripped system.
- (7) Orange indicator (one per system controlled) - indicates fire detection system activation. Locate on bottom of all graphical display screens.

9. Special Control Functions:

a. Security/Fire Doors:

- 1) Provide connection to limit switches and/or other monitoring devices on security/fire doors and additional contacts, if necessary, for monitoring of door open and door closed positions, and operational status of the door. These contacts shall be used for monitoring purposes by the baggage system and the Access Control System.
- 2) Provide photosensor at security/fire door to detect presence of baggage. If baggage is detected, the conveyor belt shall advance to deliver the bag. If baggage is still detected, the warning system shall sound. This photosensor shall not function in this manner when the fire detection system interface is activated.
- 3) Doors that are strictly fire doors and do not provide a security function, as indicated in the door schedule on the drawings, shall function the same as security doors at all times, except in the event of a fire, when they shall operate as indicated herein in the "Description of Operation" for each type of baggage system. Fire doors shall be provided with fusible links and labeled for the required fire rating by UL or an approved testing laboratory as described herein.
- 4) Doors with security function shall operate as indicated herein in the Description of Operation.
- 5) Both types of door, security and fire shall be closed during automatic system time-out.
- 6) The BHSC shall provide doors that meet the requirements of these specifications and the requirements/physical constraints within the location of installation.

b. Hold-In Circuit:

- 1) PLC logic shall be designed in the PLC program to ensure that all timers shall stop and not time out whenever a system is stopped, so that no baggage can generate false alarms or become stranded between the load belt and the bag room or claim device. On a jam in the subsystem, it does not make any difference if the subsystem times out. Once the jam is cleared and the Jam Reset PB is pressed to clear the jam, the subsystem shall restart. Therefore, the PLC logic is not an issue for the subsystem with the jam. The issue arises with the upstream subsystems. If there are no bags on the upstream subsystems, those subsystems can be allowed to time out. When the first bag head-end stops on an upstream subsystem because the subsystem is stopped, an auto-start signal should be sent to the subsystem and the upstream subsystems. Timers should reset as long as the head-end condition is active. Subsystems should be programmed like this and a testing scenario developed, because just testing the jammed subsystem PLC logic is not adequate.
- 2) On an E-Stop in the subsystem, if there are no bags head-end stopped on an upstream subsystem or blocking an auto-start photoeye, releasing the E-Stop should not start the subsystem, even if there are bags on the subsystem. Having a subsystem start solely by the resetting of an E-Stop is not allowed. When the first bag head-end stops or blocks an auto-start photoeye on an upstream subsystem because the subsystem is stopped, an auto-start signal should be sent to the subsystem and the upstream subsystems timers should reset as long as the head-end condition is active. Subsystems should be programmed like this and a testing scenario developed, because just testing the E Stopped subsystem PLC logic is not adequate.
- 3) General: If someone activates the E-Stop, they are responsible to restart the system, unless there is an auto-start signal from an upstream subsystem. None of the systems shall overcome personnel actions of using an E-Stop.

c. Jam Sensors:

- 1) Jam photosensors and associated timers shall be positioned at the discharge end of all conveyors feeding power turns and inclines, except where power turn is located in public view behind check in counters. Jam photosensors and associated timers shall be provided for every two sections of horizontal and decline conveyor, each section of incline conveyor, and discharge end of decline conveyors feeding an adjacent conveyor section of a different slope. If baggage blocks the photosensor for a timed interval exceeding the set point of the timer (adjustable 0-10 seconds), that conveyor plus the adjacent downstream conveyor shall stop and all related upstream conveyors shall stop in a cascade shut down progressing upstream as bags block the photosensor of each section of conveyor. At power turns, spiral turns, queue conveyors, and short conveyors, where applicable, the shutdown operation shall be the same as identified above, except that the conveyor section upstream of the conveyor section shall also stop. Additionally, an alarm shall sound on the associated motor control panel (MCP), and an amber JAM light shall be lit on each associated loading belt pushbutton station, at the appropriate point on the System Status OIT located on the front panel of the affected MCP, and on the Fault Monitoring PC, where provided. The MCP shall have a button for silencing the alarm. Each jam photosensor shall be provided with an adjacent amber JAM RESET illuminated pushbutton in the associated control station. After the jam has been cleared, actuation of any JAM RESET pushbutton on the associated system shall turn off all indicator lights and restart the stopped conveyors with the Start up Warning sequence. If the bag jam shut down does not affect the public area, the Start up Warning system shall not be activated in the public area.

- 2) Additionally, jam detection circuitry shall only function when the respective conveyor is running; i.e., if a conveyor stops running and, as a result, a bag blocks a jam photosensor, no false jam indication shall be generated.
 - 3) Photosensors and reflector shall be securely and rigidly installed and located in areas not subject to misalignment by transported baggage bumping the unit.
 - 4) RESET push-buttons at make-up devices, claim devices, and in staffed areas shall be keyed.
- d. Public Accessible Emergency Stop Reset: At all E STOP pushbutton stations located in areas accessible to the public, the reset function shall be key operated in addition to resetting the pushbutton.
 - e. Emergency Stop Lanyard: Provide an E-STOP lanyard at; 1) the alarm in CBRA, 2) the clear line in CBRA, and the OOG line in CBRA.

The lanyard cable shall be mounted above the conveyor lines, as shown on the BHS contract documents. The lanyard shall be supported through eyes connected to stanchions. The lanyard cable shall be red PVC covered ¼ inch cable. The lanyard cable shall be connected to an industrial grade Emergency STOP pull switch, which shall activate the E-STOP ZONE of the belt. Provide an E-STOP RESET pushbutton adjacent to the pull switch.

Lanyard placement shall not hinder personnel movement or baggage transport spaces but shall be accessible (within 2 feet) to workers in the CBRA.

- f. Manual (“Hand”) Operation: Provide “Hand-Off-Auto” switches for all motors of the baggage systems, as indicated on the Baggage System Drawings. “Hand-Off-Auto” switches shall be wired so that when set to “Hand”, the associated conveyor section shall run continuously; when set to “Off”, the associated conveyor section shall not run; and when set to “Auto”, the associated conveyor section shall run in automated mode as controlled by the PLC. When set to “Hand” or “Off” mode, the “Hand-Off-Auto” indicator on the associated motor control panel shall be lit. Conveyor sections upstream of the conveyor section in “Hand” or “Off” shall not operate except by being set to “Hand” mode. “Hand-Off-Auto” switches shall be keyed in staffed areas. In the event that an E Stop is activated on the associated system while a section is under manual operation, that section shall not automatically restart when the E Stop is deactivated to prevent a safety hazard condition for maintenance personnel. Starting any conveyor in manual operation mode shall, at a minimum, activate the Start up Warning subsystem in the local area of the activated conveyor sections.
- g. Control Stations: Provide a control station enclosure at each conveyor section with a bag jam photosensor, mounted on the conveyor frame as required herein. Jam reset, E Stop, and other associated pushbuttons and selector switches shall be installed in these enclosures. “Hand-Off-Auto” selector switches shall be provided for each conveyor drive and may be grouped in control stations provided that the drive controlled and its associated conveyor belt are fully visible from the control station. Other control stations may be required besides bag jam reset control stations. At the entrance conveyor for the EDS units, provide a control station on the load side where shown on the drawings, which shall have an E-Stop, “Start” pushbutton, “Test Bag” switch, and “Test Bag” indicator light. At the exit conveyor for the EDS units, provide a control station on the load side where shown on the drawings, which shall have an E-Stop, “Start” pushbutton, and “Test Bag” indicator light. Along the conveyor sections, size each control station enclosure appropriately for the number of pushbuttons and switches to be installed. E Stops, jam resets, and other required pushbuttons and switches for each conveyor section shall be grouped together as appropriate, unless

noted otherwise on the drawings or herein. Separate control stations may be required for E stops as required herein. Every control station with an E-Stop shall also contain a “Start” or “Jam Reset/Start” pushbutton to restart the system after the E-Stop has been deactivated. At make up devices, provide control stations as indicated on the baggage system drawings and as required herein with E-Stop and “Start” pushbuttons. Jam Reset control stations shall be located adjacent to the associated jam photosensor, unless the jam photosensor is not easily accessed from the floor, a platform, or catwalk. In this case, the location shall be coordinated with the Owner’s representative. Each control station with a “Jam Reset/Start” push-button shall also have an E-Stop and a Jam indicator light. A jam shall only be reset by the closest Jam Reset pushbutton and the next upstream and downstream Jam Reset pushbuttons. Refer to baggage system drawings for control station configurations. Control station controls shall be as listed below, as identified herein, and as shown on the Baggage System Contract Drawings.

- 1) Control Station Illuminated maintained contact push/pull mushroom head Emergency Stop pushbuttons shall be Red.
 - 2) Control Station Jam Reset/Start pushbuttons shall be Green (keyed in staffed areas).
 - 3) Control Station Jam indicator lights shall be Amber.
 - 4) Control Station Illuminated maintained contact push/pull mushroom head Emergency Stop pushbuttons shall be Red.
 - 5) Control Station Security Door Not Open/Bag on Belt indicator lights shall be Blue.
 - 6) Control Station Start pushbuttons shall be Green.
 - 7) Control Station Stop pushbuttons shall be Black.
 - 8) Control Station Bag Advance pushbuttons shall be Green.
- h. Emergency Stops, Motor Overloads, and Circuit Breakers: E Stops, motor overloads, and circuit breakers shall be zoned for shut down. E-stop Pushbuttons that are activated shall flash until reset, while the other E-stop PBs in the zone shall merely illuminate. Zones shall be wired in series. If the Highest priority zone is taken off line (due to e-stop, circuit breaker trip, or overload trip) it shall also take Zones of lesser priority off line that are up-stream. Zones of lesser priority (those upstream) shall not take Zones of Higher priority (those downstream) off line. Description of zones shall be in the Description of Operations submittal. Refer to submittal requirements.
- i. E-Stop Zoning: When one or more E-Stops are activated on a subsystem, the E-Stop zone associated with that system will cease to run until the E-Stop(s) have been deactivated and the system has been restarted. Restart after E-Stop deactivation shall be from any JAM RESET/START pushbutton in that subsystem or by Auto Start, which ever occurs first. E-Stop deactivation (mushroom head pulled out) shall place the subsystem in “Ready to Start” mode. E-Stop zoning shall conform to the following conditions:
- 1) E-Stops along the system inside the ticketing and CBIS area shall stop all of the conveyors in the ticketing and CBIS area for that system.
 - 2) E-Stops along the system inside the bag make-up area shall stop all of the conveyors in the bag make-up area for that system. Upstream conveyors in the ticketing and CBIS area shall cascade stop.

- 3) E-Stops on the conveyors at the wall between the CBIS and make-up areas shall stop all conveyors for that system.
- 4) E-Stops at a Claim Device shall stop the claim device and the associated security/fire doors.
- 5) E-Stop on the EDS unit shall stop the associated conveyor line. E-Stops on the associated conveyor line shall not E-Stop the EDS unit, but the EDS shall not deliver bags onto the dead conveyor section.
- j. System Start up: System activation from a stopped condition in a staffed area shall activate the start up sequence of the warning system as described herein prior to the systems operating. Systems shall not start up under any circumstances without activating the start up warning system procedures. Start-up warning system shall be in accordance with ANSI B-20.1.
- k. Tall Bag Indicator: Tall bags shall be detected by a photosensor mounted on the downstream control station of each inbound stripping belt or out of public view for outbound baggage conveyors where necessary. Prior to the EDS unit, this photosensor shall be set at 23" or at the lowest height restriction, whichever is less, above the belt surface. Downstream of the EDS unit, this photosensor shall be set at 36" or at the lowest height restriction, whichever is less, above the belt surface. If bags that are too tall to pass through the system are detected, the belt at the photosensor and all upstream sections shall stop and a local alarm shall sound until silenced by the reset pushbutton. Provide a tall bag reset pushbutton in the nearest control station.
- l. Bag Counters: Bag counter shall be programmed on every load conveyor of the inbound and outbound systems, and counter in programming to keep track of bags put through the system. Provide a keyed bag counter reset switch on the face of each motor control panel.
- m. Jam Counters: Jam counter shall be programmed for every jam photoeye and a jam counter for the sum of all jam photosensors. Provide a keyed jam counter reset switch on the face of each motor control panel.
- n. Shaft Encoders: Provide a digital pulse generator geared to the conveyor shaft of each section of transport and queue conveyors requiring tracking. These tachometers shall be used for tracking bags to the diverters in the system. Tachometers shall interface with PLC system.
- o. Timers: All timer functions shall be within the PLC programming, unless required otherwise for the operation or noted on the drawings.

Hand Scanner: Resolution 740 and user's requirements and standards. The scanner shall meet IATA Recommended Practice 1740d. All bar codes will be USS Interleaved 2 of 5 for both IATA 10 Digit and user's 10 Digit bar code bag tags.

- p. Manual Encoding Station: NA
- 2.1.F. Description of Operations:
1. Outbound Baggage Systems:
 - a. Overall Outbound Baggage System Description of Operation:
 - 1) Control stations for Subsystems:
 - a) The BHSC shall provide control stations to operate the designate conveyor functions of each subsystem. If the existing control stations required the counter agent to lean over the conveyor belt, the new control station shall be mounted on a stainless steel arm/stanchion, such that the control station pushbuttons are within 16" (horizontal distance) from the front edge stainless steel trim of the conveyor. If in replacing the control stations, there is no E-stop control station within every 25'-0" along the ticket counter conveyor line, a control station with an E-stop (mounted on a stainless steel arm) shall be added.
 - b) Provide a Type 1 control station that includes:

(1) A Start/Restart pushbutton	illuminated GREEN ,
(2) A Jam Reset pushbutton	illuminated AMBER
(3) An E-STOP pushbutton	illuminated RED mushroom cap,
 - c) Provide Type 2 control station that includes:

(1) An E-STOP pushbutton	illuminated RED mushroom cap,
(2) A Sonalert	audible warning
(3) An Overheight bag	illuminated WHITE lamp
An Overlength bag	White lamp shall Flash
(4) A Door Fault	illuminated WHITE lamp
(5) A Start pushbutton	illuminated GREEN ,
(6) A Jam Reset pushbutton	illuminated AMBER
(7) A by-pass key switch	
(8) A Stop pushbutton	non-illuminated BLACK
 - d) Provide Type 3 control station that includes:

(1) An E-STOP pushbutton	illuminated RED mushroom cap,
(2) A by-pass key switch	
(3) A Start/Restart pushbutton	illuminated GREEN ,
(4) A Door Fault / Jam Reset pushbutton	illuminated WHITE
(5) A Door Close	non-illuminated BLACK
(6) A Door Open	non-illuminated BLACK
 - e) Provide Type 4 control station that includes:

(1) A Start/Restart pushbutton	illuminated GREEN ,
(2) A Jam Reset pushbutton	illuminated AMBER
(3) An E-STOP pushbutton	illuminated RED mushroom cap,
(4) A STOP pushbutton	non-illuminated BLACK

f) Provide Type 5 control station that includes:

(1) A Start/Restart pushbutton	illuminated GREEN ,
(2) A Fail-Safe Reset pushbutton	illuminated AMBER
(3) A Jam Reset pushbutton	illuminated AMBER
(4) A Conveyor Advance pushbutton	non-illuminated BLACK
(5) An E-STOP pushbutton	illuminated RED mushroom cap,

g) Provide Type 6 control station that includes:

(1) A ACS by-pass	key switch
(2) A Start pushbutton	illuminated GREEN,
(3) A Fault Reset pushbutton	illuminated AMBER
(4) A Lamp Test	non-illuminated SILVER
(5) An Alarm Silence	non-illuminated YELLOW
(6) E-STOP pushbutton	illuminated RED mushroom cap,

h) Provide Type 7 control station that includes:

(1) A Start/Restart pushbutton	illuminated GREEN,
(2) A Bag Release pushbutton	non-illuminated BLACK
(3) E-STOP pushbutton	illuminated RED mushroom cap,

i) Provide Type 8 control station that includes:

(1) An AUTO/TEST	switch
(2) An INSERT BAG	illuminated BLUE
(3) An Out-of-Gauge pushbutton	illuminated WHITE
(4) A Door Fault/Jam Reset pushbutton	illuminated AMBER
(5) A Start/Restart pushbutton	illuminated GREEN,
(6) E-STOP pushbutton	illuminated RED mushroom cap,

j) Provide Type 9 control station that includes:

(1) A TEST BAG reset	illuminated BLUE
(2) A Door Fault/Jam Reset pushbutton	illuminated AMBER
(3) A Start/Restart pushbutton	illuminated GREEN,
(4) E-STOP pushbutton	illuminated RED mushroom cap,

k) Provide a Type 10 control station that includes:

(1) An E-STOP pushbutton	illuminated RED mushroom cap,

l) Adjacent to both the Type 2 and Type 3 control stations, the ACS Contractor shall provide an Access Control station, to enable the START pushbutton. The ACS card reader shall not be more than 16" from the control station it serves. A by-pass key-switch shall be provided as part of the primary and secondary control stations and shall be used to enable the START pushbuttons of the primary and secondary control stations, when the ACS is not operating correctly.

2) Ticket Counter Conveyors:

- a) Start of the BHS at Ticket Counter Load Conveyor: The BHS shall be started through a START pushbutton in each of the control stations at each end of the loading belt. These START pushbuttons shall be enabled by a security access card reader/keypad, replaced by the Security Access Control System (ACS) Contractor. Once the activation of the baggage system has been approved by the ACS, pushing the START pushbutton shall activate the beacons and audible warning subsystems along the associated conveyor system and in the make-up areas, as required by code. After a predetermined time delay (adjustable 10 to 60 seconds), the security/fire door shall open, and the visual and audible warning subsystems shall shut off. Once the security door is fully open (as the limit switch in the high position indicates the baggage system shall be activated, and the baggage system (ticket counter conveyor line and the make-up carousel shall start). The “Start” pushbuttons at the load conveyors shall activate the transport conveyors in a sequenced order starting from the downstream end (the make-up carousel). However, the load conveyors and the conveyor immediately downstream of the security door shall start immediately when the security door is fully opened. If bags that are transported on these immediately started conveyors reach the end of the conveyor immediately downstream of the security door and the downstream conveyors have not started yet due to sequenced start-up, the conveyor shall head-end and cascade stop the conveyors until the downstream conveyors start. A start photoeye shall activate the start beacon in the make-up area, prior to starting the make-up system. Beacons along the associated conveyor system, and make-up areas; as required by code, shall also be activated. Baggage system shall also be started by any of the “Jam Reset/Start” pushbuttons on the system provided that the security door has been opened via an associated security access control system reader and the limit switch indicating door fully open has enabled the baggage system activation.
 - (1) A Security access card readers/keypads shall be provided/replaced by the ACS Contractor, at locations indicated on the baggage system and security system ticket counter conveyors. Refer to “Interface with Security Access Control System - Outbound System” identified herein for operational requirements.
- b) Ticket Counter System Start Downstream of Security Door: Each system shall be able to be started through any “Jam Reset/Start” pushbutton along the system but shall not start the conveyor at and upstream of the security door, unless the security door is fully open. Any “Jam Reset/Start” pushbuttons shall activate the transport conveyors in a sequenced order starting from the downstream end (at the make-up carousel). A start photoeye shall activate the start beacon in the make-up area, prior to starting the make-up system. Beacons along the associated conveyor system, in the stripping area, and make-up areas; as required by code, shall also be activated.
- c) Ticket Counter System Restart at Load Conveyor: Restarting the system due to stoppage from emergency stop pushbuttons, jam detection shutdowns, or overloads shall activate the Startup Warning system sequence prior to the system restarting, as required by code.
- d) Ticket Counter System Stop (Auto): Automatic stopping of each system shall be accomplished through a “last bag” photosensor located at the discharge end of each loading belt (at input belts) as shown on the drawings. Each time the system is started and when a bag interrupts the photosensor beam, the timing logic shall be reset. After a time interval sufficient to ensure that all bags in transit on the conveyor line have reached their destination, the timing logic shall time out and the transport conveyors shall stop, and the security doors shall close.

- e) Ticket Counter Belt Stop: Provide “Belt Stop” pushbuttons in the control stations at the ticket counter load conveyors. “Belt Stop” pushbuttons when pressed shall immediately stop the conveyors at and upstream of the security door and shall close the security door immediately, (Unless the door photosensor is blocked, then it will run for a predetermined time to allow the conveyor to attempt to clear the photosensor and then shall immediately stop the conveyors at and upstream of the security door and shall close the security door immediately).
 - f) Ticket Counter System Stop (Emergency):
 - (1) Each system may be stopped anytime during the normal operation by depressing one of the lighted maintained contact emergency stop (ESTOP) buttons which are to be located adjacent to the belt conveyors. E-Stop pushbuttons shall be provided in every control station containing a Start/Jam Reset push button.
 - (2) When an E-Stop button is depressed, the entire shut down zone as identified herein shall be stopped (immediately), and all upstream belts feeding the affected section shall cascade stop. When the button is depressed, the red light shall be illuminated on the actuated emergency stop pushbutton. After clearing the emergency, the system may be restarted by resetting the actuated emergency pushbutton and then pressing any “Start/Jam Reset” pushbutton on that system or by pressing the “Start” pushbutton at the ticket counter. The Start-up Warning system shall activate as required prior to the system restarting.
 - g) Ticket Counter System Stop (Fire Emergency):
 - (1) Provide circuitry, dry contacts or control relays as required for interface with the Fire Detection System, furnished and installed within this contract. In the event of a fire, a signal shall be sent to the baggage system from the fire detection system; the PLC programming shall stop all conveyors and claim devices. Dry contacts for Fire Detection System interface shall be located inside the baggage motor control panel. Coordinate interface requirements with the Fire Detection System supplier and installer.
 - (2) Circuitry shall be designed to immediately stop all conveyors on the input side of the security/fire doors, and after a 10 second delay, the conveyors on the discharge side of the security/fire door shall stop and the door shall descend.
 - (3) System restart shall be accomplished through the system startup procedure.
- 3) Curbside Conveyors – Alternate 1
- a) Start of the BHS at Curbside Load Conveyor: The BHS shall be started through a START pushbutton in each of the control stations at each end of the loading belt. These START pushbuttons shall be enabled by a security access card reader/keypad, replaced by the Security Access Control System (ACS) Contractor. Once the activation of the baggage system has been approved by the ACS, pushing the START pushbutton shall activate the beacons and audible warning subsystems along the associated conveyor system and in the make-up areas, as required by code. After a predetermined time delay warning subsystems shall shut off. Once the security door is fully open (as the limit switch in the high position indicates the baggage system shall be activated, and the baggage system (ticket counter conveyor line and the make-up carousel shall start). The “Start”

pushbuttons at the load conveyors shall activate the transport conveyors in a sequenced order starting from the downstream end (the make-up carousel). However, the load conveyors and the conveyor immediately downstream of the security door shall start immediately when the security door is fully opened. If bags that are transported on these immediately started conveyors reach the end of the conveyor immediately downstream of the security door and the downstream conveyors have not started yet due to sequenced start-up, the conveyor shall head-end and cascade stop the conveyors until the downstream conveyors start. A start photoeye shall activate the start beacon in the make-up area, prior to starting the make-up system. Beacons along the associated conveyor system, and make-up areas; as required by code, shall also be activated. Baggage system shall also be started by any of the “Jam Reset/Start” pushbuttons on the system provided that the security door has been opened via an associated security access control system reader and the limit switch indicating door fully open has enabled the baggage system activation.

- (1) A Security access card readers/keypads shall be provided/replaced by the ACS Contractor, at locations indicated on the baggage system and security system ticket counter conveyors. Refer to “Interface with Security Access Control System - Outbound System” identified herein for operational requirements.
- b) Curbside Subsystem Start Downstream of Security Door: Each system shall be able to be started through any “Jam Reset/Start” pushbutton along the system but shall not start the conveyor at and upstream of the security door unless the security door is fully open. Any “Jam Reset/Start” pushbuttons shall activate the transport conveyors in a sequenced order starting from the downstream end (at the make-up carousel). A start photoeye shall activate the start beacon in the make-up area, prior to starting the make-up system. Beacons along the associated conveyor system, in the stripping area, and make-up areas; as required by code, shall also be activated.
- c) Curbside Subsystem Restart at Load Conveyor: Restarting the system due to stoppage from emergency stop pushbuttons, jam detection shutdowns, or overloads shall activate the Startup Warning system sequence prior to the system restarting, as required by code.
- d) Curbside Subsystem Stop (Auto): Automatic stopping of each system shall be accomplished through a “last bag” photosensor located at the discharge end of each loading belt (at input belts) as shown on the drawings. Each time the system is started and when a bag interrupts the photosensor beam, the timing logic shall be reset. After a time interval sufficient to ensure that all bags in transit on the conveyor line have reached their destination, the timing logic shall time out and the transport conveyors shall stop, and the security doors shall close.
- e) Curbside Subsystem Load Belt Stop: Provide “Belt Stop” pushbuttons in the control stations at the ticket counter load conveyors. “Belt Stop” pushbuttons when pressed shall immediately stop the conveyors at and upstream of the security door and shall close the security door immediately, (Unless the door photosensor is blocked, then it will run for a predetermined time to allow the conveyor to attempt to clear the photosensor and then shall immediately stop the conveyors at and upstream of the security door and shall close the security door immediately).
- f) Curbside Subsystem Stop (Emergency):
 - (1) Each system may be stopped anytime during the normal operation by depressing one of the lighted maintained contact emergency stop (E-STOP) buttons which are to be

located adjacent to the belt conveyors. E-Stop pushbuttons shall be provided in every control station containing a Start/Jam Reset push button.

- (2) When an E-Stop button is depressed, the entire shut down zone as identified herein shall be stopped (immediately), and all upstream belts feeding the affected section shall cascade stop. When the button is depressed, the red light shall be illuminated on the actuated emergency stop pushbutton. After clearing the emergency, the system may be restarted by resetting the actuated emergency pushbutton and then pressing any “Start/Jam Reset” pushbutton on that system or by pressing the “Start” pushbutton at the ticket counter. The Start-up Warning system shall activate as required prior to the system restarting.

g) Curbside Subsystem Stop (Fire Emergency):

- (1) Provide circuitry, dry contacts or control relays as required for interface with the Fire Detection System, furnished and installed within this contract. In the event of a fire, a signal shall be sent to the baggage system from the fire detection system; the PLC programming shall stop all conveyors and claim devices. Dry contacts for Fire Detection System interface shall be located inside the baggage motor control panel. Coordinate interface requirements with the Fire Detection System supplier and installer.
- (2) Circuitry shall be designed to immediately stop all conveyors on the input side of the security/fire doors, and after a 10 second delay, the conveyors on the discharge side of the security/fire door shall stop and the door shall descend.
- (3) System restart shall be accomplished through the system startup procedure.

4) Checked Baggage Inspection System:

- a) All originating bags shall be screened and only cleared bags shall be sent to the outbound make-up devices for transport to the aircraft. Transfer bags will be screened at the point of origin and will not be input into this system, unless noted otherwise.
- b) Oversize baggage: If a bag on the ticket counter line blocks the overheight PE (or blocks the lower PE at the Ticket Counter lines’ security door for more than the designated time [programmable]), the bag shall be removed and manually delivered to the Oversized baggage Screening tables for inspection by the TSA.
- c) Level 1 EDS Machine: The EDS unit shall process the bag and the status of the bag (Cleared, Alarmed, or EDS Unknown) provided by the EDS shall be tied to the unique bag ID and the information shall be sent to a database in the baggage Supervisory Control System. Bags that have been processed by Level 1 EDS shall be routed by the baggage system as follows:
 - (1) Cleared Bags: Bags that are “Cleared” by the Level 1 EDS unit shall be diverted to the ‘clear line’ at the First Chance VSU for transportation to the make-up device.
 - (2) Alarmed Bags: Bags that are “Alarmed” by the Level 1 EDS unit shall be diverted to the OSR line at the First Chance VSU

- (3) Unknown Bags: Bags that are identified as “EDS Unknown” by the Level 1 EDS unit shall be diverted to the OSR line at the First Chance VSU
- d) Level 2 Remote On-Screen Resolution (OSR): Level 2 On-Screen Resolution Monitoring will be performed at the Remote Resolution Station which allows monitoring of suspect bag images from the Level 1 EDS unit on the same conveyor line. The BHS System shall provide at least 45 seconds of travel time for Level 2 On-Screen Resolution review of the suspect bag flow coming out of the Level 1 EDS units before it reaches the Level 2 OSR Decision Point (2nd Chance VSU). Remote Resolution Station equipment will be provided by the TSA. Remote Resolution Station equipment will be located in the OSR room. When the On-Screen Resolution is complete, the status of the bag along with the associated unique ID number will be sent to the baggage system Supervisory Control System for updating the BHS/EDS Database (tracking record).
- e) Level 3 CBRA: Bags that remain alarmed after Level 2 On-Screen Resolution Monitoring shall be diverted on the queue belts of Alarm Line from the 2nd chance divert VSU. In CBRA each bag will be transported to the next available Level 3 CBRA station; the BHS shall deliver to the Baggage Removal Point (BRP) on the conveyor line. When a bag stops at the Baggage Removal Point, the associated Bag Status Display shall display the appropriate status information for that bag. When a bag is to be moved from a BRP, to a Baggage Inspection Station (BIS), the user shall access the associated Bag Status Display at the BRP to send the bag’s status information to the Bag Status Display at the intended BIT. Follow the requirements for PGDS v 7.0 for the actions of the BSD.
- f) Once the bag has been moved to the BIT and the EDS Secondary Viewing Station (SVS) is ready to receive an image, the user shall request the image for the SVS by accessing the BSD at the BIS and pressing “Send BAIT” on the touch screen display. This shall transfer the bag’s ID to the EDS interface to request the bag’s image to be displayed at the associated SVS.
- (1) Bag Status Display at the Baggage Removal Point (BRP):
- (a) Displays shall be set up in accordance with the PGDS v 7.0.
- (2) Bag Status Display at the Baggage Inspection Station (BIS):
- (a) Displays shall be set up in accordance with the PGDS V 7.0.
- g) The BHSC shall obtain a copy of the Installation and Integration Manuals from the EDS vendor for the EDS units provided by TSA.
- h) In the CBRA, the operation will follow standard industry requirements utilizing Baggage Removal Point - Baggage System Displays (BRP-BSD) and Baggage Inspection Station - Baggage System Displays (BIT-BSD) to properly transfer baggage information to and from the independent EDS units.
- i) Fail safe operation conveyor shall be provided immediately downstream of the Cleared/Alarmed Bag Decision Points to stop and have the ‘non-cleared’ bag stopped while alarms are provided at the fail-safe location and on the graphics systems. Stopped fail safe bags shall require manual intervention, not allowing the bag or bags to be transported to the make-up device.

- (1) A control station shall be provided at the headend of the fail-safe conveyor. The control station shall include a 'conveyor advance' and an E-STOP at a minimum. A stack light with a blue fault light and audible alarm shall be included with the control stations.
 - (2) A reel for lowering heavy bags to the floor level; see the BHS drawing set.
 - (3) The bag shall be manually placed on the OSR or Alarm line.
- j) Image Quality Test Mode: Each of the EDS conveyor lines (ED#) shall be programmed to operate in an Image Quality Test Mode which shall be activated by a selector switch in the control station at the EDS entrance queue conveyor on the load side of the conveyor. When the selector switch is placed in the "IQ Test" position, the EDS entrance and EDS exit conveyors shall stop. The Image Quality Test Bag will be placed on the EDS entrance queue conveyor and the "Insert Test Bag" pushbutton in the control station at the EDS exit queue conveyor on the load side of the conveyor shall be pressed to transport the test bag into the EDS unit and when processed, the test bag shall be fed onto the EDS exit queue conveyor and stop when it breaks the photoeye beam at the downstream end of the EDS exit queue conveyor. When the test bag is manually removed from the EDS exit queue conveyor, an "Exit Reset" pushbutton shall be pressed to reset the operation. This shall allow the Image Quality Test Bag to be re-run or allow the subsystem to be taken out of Image Quality Test Mode. When IQ Testing is complete, the "IQ Test" selector switch shall be switched to the "Auto" position, which shall set the subsystem to automatic operation allowing bags to continue to be screened. Image Quality Test Mode shall functionally stop the normal flow of bags into the EDS without losing track of bags that are already in the system.
- (1) A Type 8 control station shall be provided to start the Image Quality Test
 - (2) A Type 9 control stations shall be provided to stop the Image Quality Test.
- k) Bags that arrive in CBRA with an EDS faulted condition and there is no image associated with the bag can be rescreened.
- l) Oversize bags that cannot be sent through the EDS units shall be manually transported to the Oversize Baggage Screening stations, where it will be screened via ETD and inspection protocols.
- m) CBIS/CBRA Start: Each system shall be able to be started through any "Jam Reset/Start" pushbutton along the system but shall not start the conveyor at and upstream of any security door, unless the security door is fully open. Any "Jam Reset/Start" pushbuttons shall activate the transport conveyors in a sequenced order starting from the downstream end. A start photoeye shall activate the Start-up Warning systems along the associated conveyor system and in the make-up area prior to starting the system.
- n) CBIS/CBRA Restart: Restarting the system due to stoppage from E-Stop pushbuttons shall be done by pressing any "Jam Reset/Start" pushbutton along the system after the activated E-Stop pushbutton has been reset. Restarting the system due to stoppage from time out shall be done by pressing any "Jam Reset/Start" pushbutton along the system. Restarting the system due to stoppage from a jam condition shall be done by pressing a "Jam Reset/Start" pushbutton at the jam condition, at the next upstream "Jam Reset/Start" control station, or at the next downstream "Jam Reset/Start" control station in that system after the jam condition has been cleared. Restarting the system due to stoppage from circuit breaker trips, overloads, or other system faults shall be done by pressing the "Start" pushbutton on the motor control panel. Restarting the system shall activate the Startup

Warning system sequence prior to the system restarting. Systems shall not start up under any circumstances without activating the Startup Warning system sequence.

- o) CBIS/CBRA Stop (Auto): Automatic stopping of each system shall be accomplished through a “last bag” photosensor located at the upstream end of the system. Each time the system is started and when a bag interrupts the photosensor beam, the timing logic shall be reset. After a time interval sufficient to ensure that all bags in transit on the conveyor line have reached their destination, the timing logic shall time out and the transport conveyor shall stop.
- p) CBIS Stop (Emergency):
 - (1) Each system may be stopped anytime during the normal operation by depressing one of the lighted maintained contact emergency stop (E-Stop) pushbuttons which are to be located adjacent to the belt conveyors. E-Stop pushbuttons shall be located at a maximum of fifty-foot intervals along the conveyors. E-Stop pushbuttons shall be provided in every control station containing a “Jam Reset/Start” pushbutton.
 - (2) When an E-Stop button is depressed, the entire shut down zone shall be stopped, including all upstream belts feeding the affected section. When the button is depressed, the red light shall be illuminated on the actuated emergency stop pushbutton. After clearing the emergency, the system may be restarted by resetting the actuated emergency pushbutton and then pressing any “Jam Reset/Start” pushbutton on that system. The Start-up Warning system shall activate as required prior to the system restarting, as described herein.
- q) CBIS Stop (Fire Emergency):
 - (1) Provide circuitry, dry contacts or control relays as required for interface with the Fire Detection System, furnished and installed within this contract. In the event of a fire, a signal shall be sent to the baggage system from the fire detection system; the PLC programming shall stop all conveyors and claim devices. Dry contacts for Fire Detection System interface shall be located inside the baggage motor control panel. Coordinate interface requirements with the Fire Detection System supplier and installer.
 - (2) System restart shall be accomplished through the system startup procedure.

5) Sortation: NA

b. Oversize Conveyors: NA

2. Inbound Baggage Systems: NA

2.2 BELTED BED CONVEYORS:

2.2.A. Description:

- 1. General use steel frame slider bed conveyors for normal and high speed operations.

2.2.B. Drives:

1. Motors:

- a. The conveyors shall be driven by motors that conform to A.I.E.E. and N.E.M.A. standards. These motors shall be equipped with two groove minimum, taper lock type hub, V belt sheaves. Motors shall be sized for maximum load and belt speed requirements under continuous operation (minimum size 1 H.P.), and shall be capable of withstanding shock caused by frequent starting and stopping under full load where applicable. If overrun is critical to system control operation, motors shall be equipped with automatically applied brakes to prevent overrun after the motors have been de energized. All motors shall be NEMA "Premium"/IE3, utilize a "T Frame" base, and be provided with overload protection of each leg in the control panel. C-face motors (NEMA "High Efficiency"/IE2) shall be used where necessary. Bolts for mounting of motors shall be welded to motor mount frame for easy replacement of motors.
- b. Motors shall be in accordance with Energy Independent and Security Act (EISA) standards, IEEE, and NEMA, standards. Motors shall meet EISA efficiency ratings and shall be wired for operation with 230/460 volt, 3-Phase, 60 Hz power. All motors shall be copper wound NEMA TEFC with a service factor of 1.15. Speed under full load shall be constant at approximately 1800 RPMs. Type shall be Baldor, General Electric, US Motor, SEW-Eurodrive, or approved equal.
- c. On all conveyor sections with frequent start/stop operations, such as indexing belts, all motors shall be a continuous running NEMA Premium or High Efficiency, where applicable, design coupled with an electro magnetic clutch brake arrangement, where VFDs are not provided.
- d. The D.C. power supply for the clutch/brake units shall embody separate, adjustable torque/voltage outputs for both the clutch and the brake.
- e. Motors for all VFDs shall be inverter ready type that are suitable for VFD operation, shall meet applicable EISA required efficiency ratings, and shall be wired for operation with 230/380 volt, 3-phase, 60 Hz power. All motors shall be copper wound NEMA TEFC with a service factor of 1.15.
- f. Clutch/Brakes shall have anti-seize or some other application applied to the unit as recommended by the manufacturer prior to assembly with motor to prevent rust corrosion and allow for easy removal of clutch/brake from motor.
- g. Variable Frequency Drives shall be as specified herein. All VFD driven conveyors shall have a 'motor to final drive' ratio that results in top design speed with the motor running at no less than 6Hz and no more 60Hz. The design horsepower shall take into account that horsepower is proportional to Hz Running/ Hz Rated while operating below 60Hz and no greater than nameplate operating above 60Hz.
- h. See electrical section for other requirements.

2. Reducers:

- a. Shaft mounted Reducers: All shaft mounted reducers shall be shaft mounted, taper bushing type, double reduction speed reducers with two groove minimum V belt sheaves.
- b. In line Reducers: Reducers shall utilize "C Face" motor and be taper bushing type with two groove minimum V belt sheaves.

- c. Right Angle Reducers: Reducers shall utilize “C Face” motor.
 - d. Reducers are to be sized for Class II applications as a minimum. Reducers used on inclines where rollback would be critical, shall be equipped with a motor brake or “Backstop” device.
 - e. All sheaves shall be groove type, for “A” section V-belts, “3VX” section V-belts, “AX” Cog V-belts, or equal, with Type QD split bushing or tapered split bushing.
3. Drive Sections:

- a. All drive units shall be equipped with removable belt/chain guards. Drip pans are required for all reducers and motors.
- b. All conveyor sections shall have mounted-type intermediate drive assemblies. Where maintenance access to an intermediate drive assembly is difficult or not possible, an end drive assembly can be used provided that the configuration and location has been accepted by the Owner. Contractor shall submit recommended locations for end drives for approval. End drives are acceptable on queue conveyors.
- c. All lubrication points shall be easily accessible.

2.2.C. Pulley Assemblies:

1. Pulley and Shaft Requirements: All pulleys and shafts shall be sized either as indicated herein or per ANSI/CEMA B105.1, latest revision. Pulleys and shafts sized per ANSI/CEMA B105.1, latest revision shall comply with all applicable ANSI/CEMA requirements, and the requirements specified herein, unless in conflict with ANSI/CEMA. Baggage System Contractor shall indicate on their submittals which method used for sizing pulleys and shafts.
2. Power Pulleys:
 - a. All power pulleys for intermediate type drives shall be lagged with a minimum 3/8” thick vulcanized lagging of 50 60 durometer and be trapezoidal faced and equipped with taper lock hubs and 1 7/16” minimum diameter C1018 C.R.S. shafts mounted in eccentric locking type precision and ground flange type ball bearing units. Pulleys and shaft sizes are determined by maximum belt pull, and there are four classes which are as follows:
 - 1) Light Duty (250 pounds maximum belt pull) consists of a 6 3/4” minimum diameter drive pulley with a 1 7/16” minimum diameter shaft. Where used, roller chain shall be RC 60.
 - 2) Normal Duty (500 pounds maximum belt pull) consists of an 8 3/4” minimum diameter drive pulley with a 1 11/16” minimum diameter shaft. Where used, roller chain shall be RC 60 or larger.
 - 3) Intermediate Duty (1,000 pounds maximum belt pull) consists of a 10 3/4” minimum diameter drive pulley with a 1 15/16” minimum diameter shaft. Where used, roller chain shall be RC 60 or larger.
 - 4) Heavy Duty (1,500 pounds maximum belt pull) consists of a 12 3/4” minimum diameter drive pulley with a 2 3/16” minimum diameter shaft. Where used, roller chain shall be RC 80 or larger.

3. End Drive Power Pulleys:

- a. Power pulleys for end type drives or power take offs shall be lagged with a minimum 3/8" thick vulcanized lagging of 50 60 durometer, and be 6" diameter (minimum) trapezoidal faced and equipped with taper lock hubs and 1 7/16" minimum diameter C.R.S. shafts mounted in eccentric locking type precision and ground flange ball bearing units. End type drive units shall not be used for conveyors exceeding 25' in length.

4. Head and Tail Pulleys:

- a. All non-powered head and tail pulleys shall be of steel, trapezoidal faced, equipped with taper lock type hubs and 1 7/16" minimum diameter AISI 1018 C.R.S. shafts mounted in eccentric locking type precision and ground flange type ball bearing units. All head and tail pulleys shall be 6" in diameter minimum x 10-gauge wall. Pulleys shall be of a single piece steel construction and have steel end discs attached to the rim by continuous welding. Slider bed shall be arranged to keep the gap between the end section and the end pulley to a minimum. All head and tail pulleys used for belt tracking shall be equipped with jacking bolts to facilitate adjustment.
- b. All pulleys are to be statically balanced when operating speeds exceed 200 rpm, and dynamically balanced when speeds exceed 500 rpm. Rollers of eccentric material, such as standard pipe, are to be statically balanced when operating speeds exceed 200 rpm, and dynamically balanced when speeds exceed 400 rpm. Rollers made of seamless tubing may be used without balancing at speeds up to 1000 rpm, providing straightness is held to close limits and excessive welding flash is not present; for speeds in excess of 1000 rpm, dynamic balance is required.

5. Return Idlers:

- a. The return rollers shall be a minimum of 2 1/2" diameter, 12-gauge steel equipped with an 1 1/16" hex axle.
- b. All hex shaft return idler rollers shall be equipped with sealed, permanently lubricated, caged, semi precision type ball bearings. Return idlers shall be located on centers not to exceed ten feet, with spacing being reduced in areas where belting may drag against the floor or conveyor structure. The shafts shall be mounted to the conveyor bed with adjustable retainers for proper belt tracking.

6. Snub Pulleys:

- a. All snub pulleys shall be a minimum of 3 1/2" in diameter, steel, trapezoidal faced, and equipped with taper lock type hubs and 1 7/16" minimum diameter C1018 C.R.S. annealed and machined steel shafts mounted in eccentric locking type precision and ground flange type ball bearing units. All snub rollers used for belt tracking shall be equipped with jacking bolts to facilitate adjustment.

7. Take Ups:

- a. All take up pulleys shall be a minimum of 4" in diameter, steel, trapezoidal faced and equipped with taper lock hubs and 1 7/16" minimum diameter AISI 1018 C.R.S. shafts mounted in eccentric locking type precision and ground flange type ball bearing units. Pulleys shall be mounted on threaded take up devices with steel guides and a minimum of 6" adjustment. All conveyors shall be provided with take ups for field adjustment of a minimum of 2% of the conveyor bed length. Take ups shall be an integral part of the drive frames on all intermediate drive conveyors.

- b. All conveyor sections in excess of 50' in length operating in tunnels or outside of the building subject to extreme temperature and humidity' changes shall be equipped with automatic take up devices.
 - c. All take ups used in heavy duty or high-speed applications shall be the same as above except shall be of 6" diameter with 1 7/16" diameter shafts.
8. Bearings:
- a. Sealed-for-Life Bearings: All bearings shall be sealed-for-life, self-aligning, anti-friction type. Bearings shall be mounted on the outside of the conveyor frame unless clearance restrictions prohibit.
 - b. Greaseable Bearings: All bearings shall be greaseable, sealed, self-aligning, anti-friction type. In areas of difficult maintenance access, remote polypropylene lubrication lines with zerk mounted in top horizontal surface of sideguard as specified herein shall be provided for easy maintenance within the immediate vicinity of the bearings, unless noted otherwise. Lubrication lines for conveyor in public view shall be concealed from view but shall be located for easy access. Along catwalks and where conveyor equipment is not accessible, the lubrication ports shall be remotd to accessible locations with zerk mounted in top horizontal surface of sideguard within the immediate vicinity of the bearings. Bearings shall be mounted on the outside of the conveyor frame unless clearance restrictions prohibit.
 - 1) Bearings shall be greased when installed per manufacturer's recommendations.
 - 2) All lubrication points shall be easily accessible. Bearings that are blocked, covered, or inaccessible without removing shrouding or trim shall require remote lubrication lines.
 - 3) All bearings in public areas that are covered by shrouding shall be piped to a remote manifold location that is easily accessible.
 - 4) Remote lubrication lines shall be and polypropylene, translucent, 1/4" OD minimum tubing with brass zerk fittings. Remote lubrication lines shall be filled with lubrication approved by the manufacturer.
 - c. All bearings are to be Dodge D LOK Series, Fafnir RJC Series, Sealmaster SF or SFT Series, or equal.
 - d. All exposed bearings in work areas shall be equipped with bearing covers and meet OSHA requirements for employee safety. Bearing covers shall be provided on all conveyors that are in tenant work areas, accessible to tenant personnel; in public areas, and accessible to the public.
 - e. Bearings shall have a minimum L 10 life of 70,000 hours based on the service and loading of conveyors and on the manufacturer's published data showing load rating of each bearing used.

2.2.D. Belting:

- 1. All belting shall have a strength equal to or greater than 120 PIW American Style or 10n/mm European Style. Belting shall be of the types identified below as manufactured by Ammeraal, Fenner/Dunlop, Goodyear, Habasit, Nitta, Siegling, or approved equal.

2. All belting for level transport, feeder lines, or incline and decline conveyors up to 7 degrees and exposed to public view shall have a black to gray cover and bare x bare or bare x friction surface.
3. All belting for level transport, feeder lines, or incline and decline conveyors up to 7 degrees and not exposed to public view shall be bare x bare or bare x friction surface. Acceptable types are: Goodyear “PKG 125SU FBB”, Siegling “Transilon – E 12/2 0/V1 M-SE”, Siegling “Transilon – E 12/2 0/V1 M-FR Green TXGD6” Ammeraal “Flexam EX 10/2 0+00 Black AS FR IR”, Ammeraal “AMM-PLY 120 FR FxB Black”, Fenner/Dunlop “FDI 120PH FR FxB (PVK 125)”, or equal.
4. Belting for all incline and decline conveyors with 7 degrees to 18 degrees slope shall be longitudinal grooved x bare or friction surface; or diamond type x bare or friction surface. Acceptable types are: Goodyear “PKG 125SU G2BB”, Siegling “Transilon – E 12/2 V1/V10 LG-M-SE Black”, Siegling “Transilon – E12/2 0/V10 LG-M-FR Green TXGD6”, Ammeraal “Flexam EX 10/2 0+A32 Black AS FR IR”, Ammeraal “NR EF 16/2 0+C52 NR Black Siped”, “Fenner/Dunlop “FDI 120 FR CxB”, or equal. All Diamond Top belting shall be “siped” diamond pattern.
5. Belting on incline and decline conveyors greater than 18 degrees shall be longitudinal grooved x bare or friction surface; or diamond type x bare or friction surface. Acceptable types are: Ammeraal “Flexam EX 10/2 0+A32 Black AS FR IR”, Goodyear “PKG 125SU G2BB”, Nitta “BLRB 16A”, Fenner/Dunlop “FDI 120PH FR MRTxB (PVK 125)”, or approved equal.
6. Belting on queue conveyors shall be longitudinal grooved x bare or friction surface. Acceptable types are: Ammeraal “Flexam EX 10/2 0+A32 Black AS FR IR”, Siegling “Transilon – E12/2 0/V10 LG-M-FR Green TXGD6”, Goodyear “PKG 125SU G2BB”, Fenner/Dunlop “PHR 2-90MF FR LxBB”, or equal.
7. Load/unload queue conveyors shall be Ammeraal “Flexam EX 10/2 0+05 Black M2 AS FR IR”, Siegling “Transilon – E 12/2 U0/V6 GSTR-C-SE”, Goodyear “PKG 125SU FBB”, or equal.
8. Load/unload conveyors shall be Ammeraal “Flexam EX 10/2 0+05 Black M2 AS FR IR”, Siegling “Transilon – E 12/2 U0/V6 GSTR-C-SE TXGD1”, Goodyear “PKG 125SU FBB”, Fenner/Dunlop “PHR 3-135MF FR BBxBB”, or equal.
9. The width of all belts shall equal the between guard dimension of the respective conveyor minus three (3) inches.
10. Belts for Power Turns shall be as recommended by the power turn manufacturer and the belting manufacturer for baggage systems.
11. Belting for Spiral Turns shall be gripping, heavy-duty type, and as recommended by the spiral turn manufacturer and the belting manufacturer for baggage systems.
12. Belt Splicing:
 - a. Belt Lacing: Each conveyor belt shall be furnished and installed in one piece and spliced at one location. All belt lacing shall be Clipper type or approved equal and sized as required for belt thickness and type per the belt manufacturer’s recommendation for each application.
 - b. Vulcanizing: Each conveyor belt shall be furnished and installed in one piece and spliced at one location. All belt vulcanizing shall be per the belt manufacturer’s recommendation for each application.

13. Belt lengths shall be cut to allow for take-up adjustment of approximately 1/2 the take-up range, after initial installation and testing.

2.2.E. Static Components:

1. Beds: Sturdy slider bed construction is required. The bed shall be constructed of #11 gauge steel with a strong and well braced frame consisting of a minimum of 5" x 1 1/2" x #11 gauge formed channel frame rails with cross braces and a maximum of 3' 4" centers on transport lines and 2' 6" centers on the loading belts. Butt type coupling joints shall be employed with the joints epoxy filled and ground smooth. Cross braces shall be located so as not to contact the belt run under normal circumstances. Bed widths are as shown on the drawings.
 - a. End brackets for head and tail pulley shaft bearings shall be constructed of a minimum of #11 gauge steel. Mounting of these bearings directly to the conveyor framework shall not be accepted.
 - b. Adjacent conveyors shall be bolted together. Welding shall not be permitted as an assembly technique.
2. Noseovers: At all transitions from incline to horizontal or horizontal to decline, the bend shall be constructed in the same manner as slider bed construction. The bed shall have a 10' 0" radius breakover slider bed as a design objective, unless noted otherwise on the drawings. Bends may have a 5' 0" radius minimum where a smaller radius is required due to space limitations. For return belt idling, noseovers shall be equipped with a snub roll.
3. Skirting:
 - a. Skirts shall be bolted to the top of the frame rails on the loading side(s) of the conveyor and shall consist of #14 gauge or heavier sheet metal approximately 6" deep with a toe space, where applicable.
 - b. Provide skirting on all load and unload conveyors in tenant staffed areas, and as shown on the baggage system drawings. Provide flared sideguard(s) on adjacent downstream conveyor, as detailed in the baggage system drawings.
4. Sideguards: Guards shall be a hot rolled steel formed channel 21" high x #14 gauge steel with stiffeners (bracing) on a maximum of 3' 4" centers on transport lines and 2' 6" centers on the loading belts. Unless otherwise noted, guards shall be required on both sides except where baggage is being loaded at which point only one guard shall be required.
 - a. The top rail of all sideguards shall be formed with a 3/4" double break to eliminate exposed sharp edges and snag points.
 - b. Butt type coupling joints shall be employed on all sideguards exposed to the commodity flow.
 - c. In conveyor tunnels and where space is limited, alternate ten foot sections of guarding on aisle or catwalk side of conveyor shall be removable to facilitate baggage removal when the system is inoperable. Such guarding shall be designed for quick and easy removal. The sideguards and slider bed conveyor design shall not require the removal of electrical equipment, bearings or return roller mounting brackets in order to remove the sideguards. See drawings for extent of requirement.

5. Protective Guarding:

a. Protective Under Bed Guarding:

- 1) All drive units shall be completely enclosed by expanded metal screen, either hinged at one end or with quarter turn fasteners at both ends, and of minimum 14 gauge steel.
- 2) All guards shall comply with applicable OSHA standards and shall have an expanded metal screen to allow belt inspection without removal of the guard. All expanded metal screen shall have a maximum size opening of 1/2 inch. Paint the screen OSHA yellow.
- 3) Provide removable expanded metal screen on the return belt side of all conveyors from 1'-4" to 8'-0" above finish floor or catwalks.
- 4) Paint all such guarding, including the pipe guard around load areas, with OSHA yellow enamel.
- 5) Underguarding shall be in accordance with ASME B 20.1, OSHA, and local code requirements.

b. End Roll/Pulley Guarding: Finger guards shall be provided on all end rolls and pulleys not covered by shrouding that are in tenant work areas, accessible to tenant personnel; in public areas, accessible to the public, and as shown on the Baggage System Contract Drawings.

6. Supports: Floor type supports shall be vertically adjustable and of sturdy design. Bracing between the vertical support legs and the conveyor bed frame shall be provided to ensure rigidity of the installed conveyor. Such supports shall be at a maximum of 5 foot centers for loading and unloading conveyors, and a maximum of 10 foot centers elsewhere. Supports are to be on vibration isolation pads and anchored to the floor using fastening methods in keeping with the floor construction. Supports shall be constructed from 12-gauge material or heavier.

7. Hangers: Ceiling hangers shall be limited to a maximum load of 750# each. Hangers shall be spaced at a maximum of 10 foot centers, and, in general, shall be located at the discretion of the Installer except where specific requirements are shown on the drawings. All hanger connections shall be double nutted, if bolted, or have similar safeguards to avoid loosening from vibration. Vibration isolators shall be spring or neoprene type.

8. Padding: Provide 1-inch thick foam rubber pipe insulation on all conveyor supports, conveyor edges, or any other new or existing equipment located less than 6'-8" above catwalks and above conveyor where catwalk is not provided adjacent to the conveyor.

9. Painting:

- a. All structural parts, except those surfaces coated with a galvanized coating, and those that would normally be unpainted (such as rollers, shafts, sprockets, bearings, chains, nameplates, etc.) shall be painted with two shop coats of rust inhibiting enamel. This includes all support structure, bed underside, drive structure and pulley guards, etc. Paint the chain guards OSHA "yellow".
- b. The conveyor bed surface or the interior surface of sideguards shall be electrostatic powder coated as described below or as approved equal.
- c. Electrostatic Powder Coating Application: All surfaces to be painted shall be thoroughly cleaned of rust, scale, oil, grease, grit, welding flash, and other forms of dirt. Paint shall be an epoxy-type powder coat. Paint shall be applied as an electrostatic spray to a film thickness of 1.5 – 2.5 mils and

cured at a minimum of 350 degrees Fahrenheit for 10 minutes. Finish shall conform to ASTM D3363 with a hardness of 3H, and shall conform to ASTM D3359B, with an adhesion and cross hatch rating of 5B PASS.

10. Shrouding:

- a. Shrouding shall be provided for conveyor equipment located in public areas as shown on the drawings. The shrouding shall be formed stainless steel, minimum 12 gauge, Type 304 with #4 brushed finish running longitudinally. All connections shall be smooth and flush without openings.
 - b. Shrouding shall be provided for conveyor equipment located in the CBIS and CBRA as shown on the drawings and shall extend from the sideguard height to the floor. The shrouding shall be formed steel, minimum 12 gauge, painted to match the conveyor bed frame. All connections shall be smooth and flush without openings. Removal of shrouding for maintenance access shall be accomplished by one person taking no more than 5 minutes.
 - c. All joints between stainless steel sections shall be uniform with adjacent surfaces properly aligned. Tolerances of joint width and surface alignment shall not exceed 1/16" per foot, which shall not be accumulative. Joints shall align properly, where joint meet and are parallel with each other.
 - d. Where stainless steel shrouding requires a laminated substrate for stiffness, the substrate shall be laminated on all surfaces for stabilization and moisture control to prevent warp age.
11. Conveyor Identification: Each conveyor section shall be permanently and indelibly marked with its respective number as shown on Baggage System Contractor's shop drawings. Each conveyor number shall be carefully and neatly painted or stenciled in a contrasting color, nominally 4" high, in a conspicuous location on the conveyor drive. Temporary markings on the conveyors or other equipment shall be made with a medium which is readily removable with water or a readily available commercial solvent, such that they may be removed without requiring refinishing of the surface on which they appear.

2.2.F. Queue and Short Conveyors:

1. On all queuing and short conveyors, where belt tracking is difficult to control, special belting or other means shall be furnished and installed to control belt alignment.
2. Queue conveyors shall be 42" in length, unless noted otherwise on the drawings. Refer to equipment schedules in the Baggage System Contract Drawings for length of queues.

2.2.G. Power Turns and Spiral Turns:

1. Turns shall be steel frame construction and shall be sized with 7' 3" approximate radius from center to inside face of outside sideguard ("C" size) or as shown on the drawings. Turns shall be sized so that the side guards of the turn match in width with the side guards of adjacent conveyors, unless noted otherwise on drawings. At the ticket counters where the conveyor turns to penetrate the backwall, the power turn shall be sized with 4' 11" approximate radius from center to inside face of outside sideguard ("B" size) or as shown on the drawings and the width shall match the width between sideguards of the adjacent downstream conveyor. Belt speed of turns, as measured on the centerline, shall be at least as fast as the input conveyor and the same speed or slower than the output conveyor.

2. Manufacturers offering products in conformance to the specifications are:
 - a. FLOmaster Division of Portec, Inc.
 - b. PSC Flow Power Turns
 - c. Transnorm Systems, Inc.
 - d. Or approved equal.
3. Power turns shall comply with the items listed below:
 - a. Belt shall be as recommended by the Power/Spiral Turn manufacturer and the belting manufacturer.
 - b. Provide grease zerks in chain cover for chain lubrication.
 - c. Sideguards: Where two or more turns are adjacent to each other, the sideguards shall be ordered from the manufacturer for the condition to reduce the gap between the end rolls. These ordered components shall be tracked properly to ensure that they are installed in the proper location and configuration.
 - d. All power turns with the sideguards removed shall have a Finger Guard type chain cover installed.

2.2.H. Merges:

1. General: All merges shall function identically, unless noted otherwise on the drawings. The merge controls shall be designed to properly insert baggage onto the primary or priority conveyor line from the associated secondary or feeding line. The conveyor line requiring priority shall run continuously when activated. When adequate space between bags is sensed in the priority line and baggage is present at the merge, the merge shall insert the bag into the space on the priority line. The PLC program shall utilize the "BIT SHIFT REGISTER" to identify the required space. Upstream of the merge section, queue or indexing belts shall be used to accumulate bags while the priority line is transporting bags. If the queue or indexing belts fill up with bags, the priority line upstream of the merge point shall shutdown for a period of time and the system shall purge the queue or index belts of bags. Once the secondary or feeding line is purged or the time interval is reached, the primary line will resume priority. If a bag waits on the merge for 2 minutes (adjustable 30 to 300 second timer) due to the priority line being full, the priority line upstream of the merge point shall shutdown for a period of time and the system shall purge the merge. Refer to the baggage system drawings for general location of merge controls.
2. 45° Continuous Belt Merge:
 - a. Where a 45 degree merge is indicated on the drawings or is required, its construction shall be typical slider bed construction with drive/take up unit at 90 degrees to the flow of baggage. Merge control sensors shall be provided to prohibit a build up of baggage at the converging point by the use of queue belts upstream of the merge. At discharge end of 45 deg. merge, provide a transition plate utilizing either a stiff bristled upturned brush or Ultra High Molecular Weight Polyethylene. If merge requires compressed air, each unit shall be provided with an air compressor and coordinated with the facility and other systems for available space around the merge unit. All equipment necessary for the operation of the merge shall be provided and coordinated by the BHSC.

3. 90° Merge: NA
4. In-Line (Plow) Merge: NA

2.2.I. Take-Aways (Reverse Merges):

1. Take-Aways shall be of the same construction as the merges listed above herein and shall operate in the reverse direction. Cascade drop from feeding conveyor to the take-away is typically a minimum of 2", but shall be per the manufacturer's/BHS controls requirements.

2.2.J. Diverters:

1. Powered Face Diverters (PFD): Any diverter immediately upstream of an EDS unit with the sole purpose of diverting bags to the EDS unit shall be a power face diverter. Pushers are not acceptable at these locations, unless specifically reviewed and approved. Provide diverters of Baggage System standard design, capable of diverting bags at a minimum rate of 60 bags per minute. A separate lockable disconnect switch shall be provided for each pusher/diverter and for each associated electric clutch/brake unit. For maintenance, a two position momentary-contact selector switch shall be provided with each pusher. The unit shall operate through one complete cycle when the switch is held in the manual position. Whenever the associated conveyor line has stopped for any reason, the unit's sensing controls and drive mechanism shall be disarmed. Diverters shall have a "Diverter Stop" pushbutton, which shall stop the pusher, the adjacent conveyor section, and the receiving conveyor.

2.2.K. Vertical Merge/Sorter Units:

1. VSU and VMU equipment provided shall be produced by manufacturers with minimum of 3 years previous installations of this equipment in airport baggage systems, and be appropriate models suited to high volume heavy duty operations of the airport BHS environment. Product manufacturer and models are subject to approval by the OAR.
2. Performance of VSU and VMU equipment shall meet all standards required for BHS in general, transporting baggage items of the full range of sizes required for the system overall smoothly and without damage, and shall meet throughput requirement of sorting 1450 BpH for sustained periods.
3. Installation must include safety guarding that protects workers from movement of machine parts while allowing visibility of operation. Guard panels must open easily for quick maintenance access and be interlocked with VSU/VMU controls to halt all machinery when open. Full maintenance access of 1.2M shall be maintained outside of safety guarding.
4. With safety guarding open installation must afford easy access to a power disconnect switch feeding all motors and powered equipment in the VSU/VMU assembly, quick replacement of belting for all paddles, and easy access for all maintenance points required by manufacturer recommendations.
5. VSU/VMU equipment shall be braced as needed to meet applicable seismic codes and is subject to vibration isolation guidelines applicable to all BHS elements. Note that special care must be taken to avoid transmission of vibration to public floors such as concourses and hold rooms.

2.3 RECIRCULATING DEVICES:

2.3.A. Flat Plate Recirculating Devices:

1. Size: Oversize width with 39"± clear conveying surface. Heights as shown on the drawings.
2. Load Rating: The maximum structural load shall be 200 pounds per lin. foot. The normal live load shall be a minimum of 75 pounds per lin. foot.
3. Flights:
 - a. The flights shall be crescent shaped conveying platforms and shall be manufactured from a minimum of ¼" C.R. steel.
 - b. For devices in public areas, the exposed surface of all flights shall be covered with a molded vulcanized black urethane or neoprene covering or other approved treatment.
 - c. Devices used in baggage make up areas shall be a minimum of ¼" C.R. steel with a black oxide finish.
4. Chain: The flights shall ride on self aligning interconnecting chain links with guide rollers.
5. Support Rollers: A minimum of two rows of 1 15/16" (min. dia.) ball bearing mounted wheels or rollers shall be used to support the flights. The rollers or wheels shall be mounted on centers so as to accommodate the static and live loads required.
6. Lubrication: A system for automatic or remote lubrication of the drive assembly and chain shall be provided.
7. Trim: Side rails shall be a 6" formed angle of #8 gauge mild steel, or 12 gauge stainless steel if used in an area exposed to the public. The trim angle also serves as a luggage and finger guard to prevent contact with the edges of the pallets.
8. Toe Space: A 6" high toe space shall be provided at the base of the skirt.
9. Finish: All surfaces exposed to the public except the conveying surface shall be Type 304 with #4 brushed finish stainless steel.
10. Drive Assembly: The drive shall consist of a heavy duty roller chain driven by a motor through gear reducer. The roller chain shall engage at least two carrier assemblies at all times.
11. Drive: The drive shall be designed for operation from a 480 VAC, 3 phase, 60 Hz power source. Each drive shall be provided with a Soft Start Controller. The drive shall be sized to permit start up under full load conditions. Motors shall be as specified for conveyor sections. Reducers type shall be Dodge "APG" series, Sumitomo "SM Cyclo" series, or equal. Soft Start Controller type shall be as specified herein.
12. Skirting: Provide continuous 14 gauge, minimum, skirting around all make-up devices, flush with toe space from base of unit to floor or work surface. Skirting shall be rigidly mounted to make-up device, but shall be removable for maintenance access.

13. Products: Manufacturers offering products in conformance with the requirements herein include: Siemens Systems, VanDerLande Industries, Beumer Group, Logan Conveyor, Glidepath, or equal.

2.3.B. Slope Plate Recirculating Devices:

1. Description: Rotating, inclined plane display devices, consisting of a stationary curb and top with a canted moving surface for baggage display constructed of linked flights and capable of operation in the configuration shown on the drawings.
2. Products: Manufacturers offering products in conformance with the requirements herein include the following:
 - a. Inclined plane device manufactured by Siemens Systems, VanDerLande Industries, Beumer Group, or approved equal.
3. Load Rating: Devices shall be capable of a minimum live load of 125# per peripheral foot, starting fully loaded.
4. Speed: Devices shall rotate at a constant peripheral speed not less than 80 FPM or greater than 100 FPM and coordinated with the input velocity of the feed conveyors. Rotation of all claim devices shall be in the same direction, unless noted otherwise on drawings (clockwise or counter clockwise).
5. Flights:
 - a. Flights and closure panels shall be fabricated from heavy gauge stainless steel. No sharp or protruding edges shall be acceptable. Fabrication shall be to close tolerance to avoid gaps capable of trapping fingers, baggage or otherwise constituting a safety hazard. Where flights are designed to bear on adjacent flights, means shall be employed to avoid deterioration, grinding and residue from such contact which would mark or stain baggage. Flights shall be fabricated for the direction of rotation and shall not produce a catch point for bags at the turns.
 - b. Flights shall be approximately 60 inches in length and set at a slope not less than 18 degrees or exceeding 22 3/4 degrees.
6. Curb: Perimeter curb shall be of formed stainless steel sections fastened with concealed fasteners or countersunk, button head or oval head matching screws. Joints shall be true and edges shall be finished. No protrusions or sharp edges shall be acceptable. Curb shall provide an adequate toe space. The back of the toe space shall be finished with a rubber base mounted with 1/2" plywood backing on claim devices and a 14 gauge metal skirt with 1/2" plywood backing on make-up devices to prevent debris from accumulating under the device.
7. Baggage Stop: A railing mounted to the floor and independent of the claim and make-up devices will be furnished and installed within the General Contract at the points where baggage is indexed onto the claim and make-up devices. The purpose of this rail shall prevent injury to passengers from claiming bags or to baggage handlers making up bags at the point where baggage is sliding down to the curb from the feed conveyor.
8. Bumper: Perimeter bumper shall be a black, resilient non marking material. The bumper shall be configured to avoid gaps or open unprotected condition at the curb, which would be hazardous.
9. Frame, Track and Drive: Frame shall be constructed of structural steel, primed and enameled except for wearing surfaces. Drive chain guideways and wheel tracks shall have tight, well aligned joints or liners

for smooth, noise free operation. Drive lugs or sprockets engaging the drive chain shall be smooth and quiet. Drives shall be protected with overload and jam protection. Frame and track shall be grounded. Drive shall be designed for operation from a 380 VAC, 3 phase, 60 Hz power source. Each drive shall be provided with a Soft Start Controller. The drive shall be sized to permit start up under full load conditions. Motors shall be as specified for conveyor sections. Reducers type shall be Dodge "APG" series, Sumitomo "SM Cyclo" series, or equal. Soft Start Controller type shall be as specified herein.

10. Deck: Raised platform consisting of a 3/4 inch fire resistant plywood deck capable of supporting 75 pounds per square foot and covered with a finish furnished and installed within the General Contract, and surrounded with special stainless steel trim in accordance with the drawings. Provide access hatches with lockable latches, flush with surface, for finish, and sized per manufacturer's requirements at locations shown on the Baggage System Contract Drawings.
11. Feed:
 - a. Feed conveyor components at the threshold of the claim device (exposed to public view) shall be constructed of stainless steel.
 - b. Side guards and trim for the feed conveyors at the openings in the claim devices' top cover shall be of special stainless steel design as shown on the drawings.
12. Transition Plate: Provide stainless steel transition plate or Ultra High Molecular Weight (UHMW) polyethylene adhered to steel substrate transition plate at gap between feed conveyor and device as detailed in the Baggage System Contract Drawings.
13. Safety Rail: In areas inside the devices where a deck is not provided, a continuous channel shall be installed along the top edge of the rotating pallets to prevent accidental injury from the rotating device. Rail shall not interfere with maintenance access to device.
14. Skirting: Provide continuous 14 gauge, minimum, skirting around all make-up devices, flush with toe space from base of unit to floor or work surface. Skirting shall be rigidly mounted to make-up device, but shall be removable for maintenance access.

2.4 MISCELLANEOUS EQUIPMENT AND MATERIAL:

2.4.A. Draft Curtains:

1. Draft curtains shall be provided where shown on the drawings and shall be flexible strip doors with two staggered layers of 8" x 1/16" strips - color "Black".

2.4.B. Curbing and Guardrails:

1. Steel tube guardrails shall be provided as shown on the baggage drawings for protection of conveyor sections, drive assemblies, and electrical hardware vulnerable to damage by tug/cart movements. (Concrete curbing, if required, will be furnished and installed within the General Contract).

2.4.C. Security/Fire Doors:

1. Security and fire doors are required as shown on the drawings and shall be 1-1/2 hour fire rated minimum, electrically operated coiling/rolling type. Door models shall be selected to conform to the limited space available inside the claim devices and within doghouses where applicable. All exposed surfaces visible to the public shall be stainless steel, type 304 with #4 brushed finish. Accessibility to all motors,

operators, emergency operators, door attachments, guide attachments, hoods, etc. shall be from the secured side of the door only, unless noted otherwise.

2. Operation: Shall be by motor operator. Power supply shall be provided through the associated baggage system and controls shall be coordinated with the baggage system. Manual operation is not allowed. Door activation shall only be through the associated baggage system, refer to “Description of Operations” as specified in this section for operational sequence requirements.
3. Curtains: At locations not visible to the public, provide interlocking slats of cold roll formed galvanized steel. At locations visible to the public, provide interlocking slats of stainless steel. Gauge to be as recommended by manufacturer to withstand applicable impact from the baggage system or other forces. Endlocks shall be attached to the slats to maintain curtain alignment and prevent lateral slat movement in accordance with manufacturer’s recommendations. Curtain shall be reinforced with a bottom bar consisting of two steel angles or a box shape.
4. Guides: Shall be roll formed steel shapes or structural steel angles as recommended by the manufacturer. Attachment to jamb shall be in accordance with manufacturer’s recommendations.
5. Brackets: Shall be steel plate to support the barrel, counterbalance, and hood, and shall be equipped with self aligning lubricated ball bearings.
6. Counterbalance: Shall be helical torsion springs housed in a steel pipe barrel, supporting the curtain with a maximum deflection of .03 inches per foot of width. Counterbalance shall be adjustable by means of an adjusting tension wheel.
7. Hood: Shall be 24 gauge galvanized primed steel minimum. Hood shall be equipped with thermally controlled internal galvanized steel flame baffle when required.
8. Locking: Gearing shall be self locking.
9. Fire Rated Doors: Where a fire rated door is required herein or as indicated on the drawings, the door shall be rated as indicated, but it shall not close automatically when a fire is detected unless specifically required by code or noted otherwise. The door shall operate as indicated in “Description of Operations” in this specification section. Fire doors shall be labeled by “Underwriter’s Laboratory” or other testing laboratory acceptable to local code authorities. Fire doors shall be provided with fusible links that if in the event of a fire and the fire is present at the door location, the door will close. If the door closes due to the fusible link, the conveyor section(s) at the door shall stop immediately. All other doors and conveyor sections shall function as indicated in the “Description of Operations”.
10. Motor Operation: Shall include 120 volt AC, single phase, high torque motor; reduction gearing; solenoid break; emergency operation; overload protection; and prewiring terminal block. Door shall be activated by the associated baggage system, refer to “Description of Operations” in this section for system sequence. Emergency operation shall be activated a security access control system card reader, furnished and installed within this contract, or a key operation if the card reader is not provided.
11. Controls: Provide limit switches or photosensors to identify when door is closed, partially open, and fully open. Switches shall be heavy duty, industrial type. Photosensors shall be as specified herein. Limit switches or photosensors shall be monitored by the associated baggage system and security access control system through the baggage control system. Coordinate baggage system and security access control system for controls interface requirements.

2.4.D. Baggage Inspection Tables (aka Baggage Inspection Stations):

1. Tables shall be 30" deep x 60" long x 30" high and positioned as shown on the Baggage System Contract Drawings. Height shall be adjustable from 28" to 32".
2. Tables shall be fabricated out of heavy gauge AISC Type 304 stainless steel with No. 4 Brush finish and smooth flush edge seams. Hardware shall be grade 5 and meet ASTM Standards.
3. Baggage Inspection Tables shall be built and installed in compliance with applicable local and federal codes, standards, laws, and regulations for this type of equipment.
4. Baggage Inspection Tables shall have drawers and vented lockable enclosure for the CPU on the other side.
5. Supports for the baggage status displays shall be adjustable in height in 5cm increments to allow the station to be set up for the users and shall be independent of the tables.
6. The SVS monitors shall be mounted on commercial system and shall be independent of the tables.

2.4.E. ETD Tables:

1. Tables shall be 24" deep x 24" long x 30" high and positioned adjacent to the Baggage Inspection Tables as shown in the drawings. Height shall be adjustable from 28" to 32".
2. Tables shall be fabricated out of heavy gauge AISC Type 304 stainless steel with No. 4 Brush finish and smooth flush edge seams. Hardware shall be grade 5 and meet ASTM Standards.
3. Tables shall be built and installed in compliance with applicable local and federal codes, standards, laws, and regulations for this type of equipment.
4. Tables shall have drawers.

2.4.F. Supervisor Desk:

1. Desks shall be durable and rigid with wood or plastic laminate tops with smooth flush edge seams. Wood shall be Rated Fire Retardant. Hardware shall be grade 5 and meet ASTM Standards. Tables shall meet the requirements for ergonomics and shall be built and installed in compliance with applicable local and federal codes, standards, laws, and regulations for this type of equipment.

2.4.G. Roller Deck:

1. Rollers of the deck shall be 2" in diameter and spaced no more than 4" on center. Rollers, attachments, frame shall be rust resistant. Rollers shall be galvanized. Frames shall be powder coated steel.
2. The roller deck shall have the capacity to support 100 pounds per SF minimum.
3. Floor supports shall be provided to raise the deck to the height shown on the BHS drawings. Attach floor supports to the finish floor (whether interior or exterior. Floor supports shall be powder coated steel. Floor supports shall be provided on both ends of the deck. The supports shall be adjustable to raise / lower the deck surface between 12" AFF and 18" AFF.

4. Where roller deck is provided with a security/fire door, the deck shall be installed with a gap (not to exceed 5") to allow the door to close to a sill, creating a complete security and / or fire closure.
5. Where roller deck is provided to deliver bags to a powered belt, the top of bed elevation of the rollers shall be 2-3" above the belt height.
6. Skirting: Provide continuous 14 gauge, minimum, skirting around all roller deck in public spaces, flush with toe space from base of unit to floor or work surface. Skirting shall be rigidly mounted to the deck but shall be removable for maintenance access.
7. Backguard: Provide continuous 14 gauge, minimum, skirting between the back-side of the roller deck and the wall. The back guard in the public spaces shall be 21" high with a width to close the gap between the roller deck and the ATO wall. Backguards shall be rigidly mounted to the deck but shall be removable for maintenance access. No backguards or sideguards shall be provided in exterior spaces.

2.5 BHS ELECTRICAL AND LOW LEVEL CONTROLS – GENERAL:

2.5.A. General:

1. Materials shall be of the quality specified herein, new, free from defects, of the best commercial/industrial grade, and approved by a nationally recognized testing laboratory wherever published standards exist. Each type of material shall be of the same make and manufacturer throughout the project. Materials shall comply with NEC or Local Code requirements, whichever are more stringent.
2. The electrical equipment identified herein is based on products by different manufacturers and indicates the level of quality and performance required for the equipment. Provided that the equipment is equal in quality and performance to that identified herein and meets the requirements of these contract documents, electrical equipment by Allen Bradley, Siemens, Schneider Electric/Square D, Cutler Hammer, General Electric, Westinghouse, or approved equal is acceptable for use in this Work.
3. Contractor shall provide either NEMA or IEC components, as listed herein, but shall provide either NEMA or IEC components for any type of component throughout the Work (no intermixing of components), unless noted otherwise or with approval by the Owner or OAR.

2.5.B. Raceways and Fittings:

1. Except as otherwise noted, all electrical wiring from the motor control panel to the conveyor shall be enclosed in conduit of trade size ¾" or larger. Individual conductors and cables that are not acceptable exposed cable or cord sets on the conveyors shall be enclosed in conduit of trade size ¾" or larger. Conduit shall be in compliance with NEC or Local Code requirements, whichever are more stringent. Except in public areas, conduit shall be installed exposed in locations selected to prevent damage to conduit by moving vehicles or equipment. In public areas, conduit runs shall be inconspicuous by running under cover plates, behind conveyors, or otherwise concealed from public view. Conduit shall be EMT above 7' 0" AFF. Conduit shall be rigid galvanized below 7' 0". Raceways shall be concealed in public and finished areas. Raceways shall be run parallel with or at right angles to the building lines. Conduits shall be grouped as practical. Provide flex connections to motor control panels. Wiring shall be installed only after conduits have been cleaned and belled. Conduits shall be sized in accordance with NEC or Local Code requirements, whichever are more stringent.

2. All flexible conduit, where used, shall be in compliance with NEC or Local Code requirements, whichever are more stringent. Flexible conduit shall be connected from wall mounted, ceiling mounted, floor mounted, or trapeze mounted conduit to conveyor sections and to motors.
3. Rigid Steel Conduit: Hot-dip galvanized. All conduit greater than 1.5" diameter shall be rigid steel conduit, unless noted otherwise.
 - a. Conduit Fittings:
 - 1) Unions: Threaded-type, Erickson or split couplings.
 - 2) Locknuts: Steel up to two-inch; malleable iron for 2-1/2 inch and larger.
 - 3) Bushings: Cadmium-plated malleable iron for 1/2 to 1 inch; phenolic-insulated type for 1-1/4 inch and larger. Note: Aluminum fittings shall not be used.
4. Electrical Metallic Tubing (EMT): Galvanized or sheradized. Minimum size shall be 3/4". All conduit 1.5" diameter or less and not susceptible to damage shall be EMT, unless noted otherwise.
 - a. EMT Fittings: Couplings and connectors shall be steel compression-ring type, rain tight and concrete tight.
5. Flexible Conduit: Galvanized steel, securely interlocked, minimum size 1/2 inch.
 - a. Flexible Conduit Connectors: Cast metal, clamp style. Screw-in type connectors are not acceptable.
6. Wireway: Hinged cover, baked enamel finish, size as required.
7. Raceway Supports:
 - a. Surface-mounted: 1-hole, malleable iron, hot-dip-galvanized straps.
 - b. Pendant-mounted: For single units, 1/4-inch rod with pear-shaped hanger; for multiple raceways or wireways, trapeze-type hanger with 3/8-inch rod, 1-5/8 inch square performed channel and pipe clamps.

2.5.C. Wire and Cable:

1. All conductors shall be copper and in accordance with NEC or Local Code requirements, whichever are more stringent. Low voltage (less than 90 volts) control wiring shall be installed in separate wireways and not combined with power or control (greater than 90 volts) wiring. Control wiring shall be installed in separate wireways and not combined with power wiring. Control wiring shall be terminated, where necessary, in junction boxes on terminal boards, make wire numbers on terminal strips. The term "conductor" as used in these specifications shall be considered as any wire cord, cable, rod, buss, fuse, or similar product designed for the transmission of electrical energy.
2. Conductors for Motor Control Only - Exterior to Motor Control Panels:
 - a. Individual conductors shall be Type THHN/THWN-2 for all wet and dry indoor locations and shall be Type XHHW-2 for exterior locations. Conductors shall be 600-volt insulation, stranded copper, Class "B" stranding, no solid conductors allowed. All power conductors shall be 12 AWG, minimum. All control wiring shall be No. 14 AWG, minimum. Grounding conductors: #6 AWG

and larger: stranded copper, bare soft drawn as required. #8 AWG and smaller: stranded copper with green insulation.

- b. Power cord sets shall be Type STOOW for all wet and dry indoor locations. Conductors shall be 600-volt insulation, stranded copper, Class “B” stranding, no solid conductors allowed. All power conductors shall be 12 AWG, minimum. All control wiring shall be No. 14 AWG, minimum. Grounding conductors: #6 AWG and larger: stranded copper, bare soft drawn as required. #8 AWG and smaller: stranded copper with green insulation. This cord type is not required to be installed in conduit. It shall either be secured to the conveyor such that it is not loose, hanging, or coiled outside of an electrical enclosure or device; or install in an approved open wireway/cable tray.
3. Conductors Motor Control Only: Interior to Motor Control Panels, conductors shall be Type MTW, 600-volt insulation, stranded copper, Class “B” stranding, no solid conductors allowed. Motor feeders shall be sized as required. All power conductors shall be 12 AWG, minimum. Control wire shall be 14 AWG, minimum.
4. Conductors for All Area Except Motor Control: Conductors shall be 600-volt. Wiring shall be run in conduit, except where specified or indicated otherwise, and conductors shall not be less than No. 12 AWG except for control wiring in conduit, which may be NO. 14 AWG and fire alarm wiring, which may be No. 16 AWG. Wire shall be furnished in types to conform to the following:
 - a. Thermoplastic Type THWN (for fire alarm circuit only): Type THWN shall bear Underwriter Laboratories approval. Conductors shall be solid. Wire shall meet the requirement of IPCEA Standards S-61-402 Copper.
 - b. Thermoplastic Type THHN/THWN-2: Type THHN/THWN-2 wire shall bear Underwriters Laboratories approval. Conductors shall be stranded having IPCEA Class “B” stranding. Wire shall meet the requirements of IPCEA Standards S-61-402 Copper.
 - c. S.O. Cord: Shall be 600-volt, heavy-duty, Type W, as manufactured by ITT, or approved equal. Size as required. This cord type is not required to be installed in conduit. It shall either be secured to the conveyor such that it is not loose, hanging, or coiled outside of an electrical enclosure or device; or install in an approved open wireway/cable tray.
 - d. Cord sets shall be Type STOOW for all wet and dry indoor locations. Conductors shall be 600-volt insulation, stranded copper, Class “B” stranding, no solid conductors allowed. All power conductors shall be 12 AWG, minimum. All control wiring shall be No. 14 AWG, minimum. Grounding conductors: #6 AWG and larger: stranded copper, bare soft drawn as required. #8 AWG and smaller: stranded copper with green insulation. This cord type is not required to be installed in conduit. It shall either be secured to the conveyor such that it is not loose, hanging, or coiled outside of an electrical enclosure or device; or install in an approved open wireway/cable tray.
 - e. VFD Power Cabling: Shall be 600-volt, heavy-duty, shielded cable with drain wire. Size as required. Type shall be as recommended by the VFD manufacturer.
 - f. Ground Wire: Ground wire shall be insulated copper with green insulation.
5. Color Coding: Baggage system phase wire colors to be: for 277/480-volt--Phase A, brown; Phase B, orange; Phase C, yellow. For 120-volt wire in control panel, red. For 480-volt wire in control panel, black. All panel wires shall have wire numbers at both ends of the wire. For DC voltage, all wire shall be blue with wire numbers both inside and outside of panels. For 120-volt AC outside of the control panel, wire may be any color except brown, orange, yellow, or blue; neutral shall be white; the color of

the wire must be consistent between panels and devices, and must be identified by wire numbers. Verify conductor color code with local electrical inspector. Where colors are not available (No. 4 and larger, or by special permission of the Owner), all wires shall be identified within panel boards, cabinets, switchboards, and other accessible locations, using Manville Dutch Brand No. 128 vinyl marking tape with color to match coding of phase wires. Wire markings shall be Brady number tape or sleeve-type number markers.

6. Manufacturer: Belden Cable, General Cable, Rome Cable, or equal.
7. Electric Tape: All taping of electrical connections shall be done with #M Scotch No. 33 plus all-weather vinyl plastic tape, or equal.

2.5.D. Boxes and Fittings:

1. Outlet and Device Boxes: One-piece pressed steel, electro-galvanized, size and depth required by code except four inch square or four inch octagonal minimum. Provide bushings or thwarted fitting on conduits without bushings.
2. Junction and Pull Boxes: Steel, screw cover, code gage and size, baked enamel finish. Junction boxes used for splicing shall be 12" x 12" minimum and contain terminal strip for all splice joints. An exception is where one or more photoelectric sensors are spliced and all components are easily accessible with wire fill shall be limited to 31% in accordance with NEC and without moving wires out of the way, a 4-11/16 junction box can be used, provided that the proper terminal strip assembly is provided. Terminal strip assembly shall include, but is not limited to; terminal blocks, mounting rail, end barrier, end anchors, jumpers (if necessary), fanning strip (if necessary), and marking system. Minimum size for all other junction boxes or pull boxes not used for splicing shall be 4 11/16" x 2 1/8" deep.
3. Fittings: Junction boxes shall be cast conduit fittings at the Contractor's option. Provide one size larger than raceway for feeders, with "mogul-type" openings. Openings shall be accessible at all times. Conduit bodies (condulets) shall be cast and limited to "LB", "LL", and "LR" types. Wire fill shall be limited to 31% in accordance with NEC.

2.5.E. Photoelectric Cell (PEC) Sensors:

1. General: Self-contained, infra-red visible beam with a range of 6" to 30 feet. The unit shall include mounting brackets, cable and reflector. All components shall be UL Listed.
2. All photosensors used for jam detection, over height bag detection, etc., shall be L.E.D. Retroreflective Type devices.
3. Construction: Sensor heads shall be molded from thermoplastic polyester with a lexan top view window. Lenses shall be acrylic and hardware shall be stainless steel. The units shall be gasketed. Operating temperature range shall be -40 to 150°F.
4. Connection: Integral standard 4 conductor quick disconnect cable fitting. Connect to fitting with matching connector and flex conduit and wire. Connecting cable and fittings shall be UL listed.
5. Mounting Bracket: Special by manufacturer with curved mounting slots and two 5/16" mounting bolts.
6. Photosensors shall be mounted on structural members attached to the machinery structure so that minimal vibration is transmitted to these units. No more than two penetrations per sensor (one each for

the photosensor and the reflector) shall be allowed in conveyor sideguards; each penetration shall not exceed 1 1/2" in diameter and shall be beveled to remove sharp edges.

2.5.F. Light Curtain Assemblies:

1. Light curtains shall be standard off-the-shelf units and shall be provided as required by the Smith's 9800 integration guide.

2.5.G. Over-height PE on Security Shunt lines :

An Over-height PE shall be provided to detect over-height bags at the second queue belt prior to each EDS.

Provide a light with audible alarm which shall announce when an over-height bag has been identified. When an over-height bag has been detected, the queue belts shall be stopped and the alarm stack light/annunciator shall sound,

Provide a reset pushbutton with the alarm stack light / annunciator.

2.5.H. Limit Switches:

1. 6-amp, 120-volt, NEMA Type 1 enclosure with roller lever. Limit switches at security and fire doors shall be mounted properly for door open and door closed operations.

2.5.I. Warning Visual Systems:

1. Warning Lights (Beacon):
 - a. System Start up: Light shall be a rotating, 120 volt AC, flat base mounting fixture with a red lens. Location as indicated on drawings.
 - b. Jam Detection/Emergency Stop: Light shall be a rotating, 120 volt AC, flat base mounting fixture with a yellow lens. Location as indicated on drawings.
2. Warning Light (Lantern):
 - a. Globe and guard. Globe color shall be as required.
3. Stacked Lights:
 - a. Stacked lights shall be of standard design with stackable white, red, yellow, green, and blue lights in arrangements and quantity of colors and lights as required herein, in the Baggage Contract Documents, and/or per required standards. Provide Allen Bradley 856T Control Tower Stack Lights or approved equal.

2.5.J. Warning Audible Systems:

1. Warning Horn:
 - a. In Baggage Make up areas and along baggage system as shown on the Baggage System Contract Drawings, provide warning horns. Horns shall be 120 volts AC, 103 dB at 10' with adjustable volume.

2. Warning Buzzer:

- a. At each claim device provide a minimum of two audible alarms located within the device. Chime/buzzer shall be 120 volts AC, 65 to 70 dB at 10'.
- b. Control Station Buzzer:
 - 1) At each control station with a START pushbutton in public areas, provide a buzzer in the control station. Buzzer shall be 60/250 volts AC with 120 volt AC supplied to the unit to provide 55 to 60 dB at 2'.

2.6 NON-DISTRIBUTED (CENTRALIZED) ELECTRICAL AND LOW LEVEL CONTROLS:

2.6.A. General:

1. Materials shall be of the quality specified herein, new, free from defects, of the best commercial/industrial grade, and approved by a nationally recognized testing laboratory wherever published standards exist. Each type of material shall be of the same make and manufacturer throughout the project. Materials shall comply with NEC or Local Code requirements, whichever are more stringent.
2. The electrical equipment identified herein is based on products by different manufacturers and indicates the level of quality and performance required for the equipment. Provided that the equipment is equal in quality and performance to that identified herein and meets the requirements of these contract documents, electrical equipment by Allen Bradley, Siemens, Schneider Electric/Square D, Cutler Hammer, General Electric, Westinghouse, or approved equal is acceptable for use in this Work.
3. Contractor shall provide either NEMA or IEC components, as listed herein, but shall provide either NEMA or IEC components for any type of component throughout the Work (no intermixing of components), unless noted otherwise or with approval by the Owner or OAR.

2.6.B. Motor Control Panels and Internal Components:

1. General:
 - a. Panels shall be designed and arranged by a control company with a minimum history of 5 years experience of previous work in conveyor systems. Control panels shall be provided fully designed and manufactured ready to install for field connected wiring. Baggage System Contractor shall install panels secured to floor to withstand earthquake conditions of 1.5 times panel force. Provide fluorescent light fixture(s) inside each motor control panel to properly light electrical equipment and tagging, which shall turn on when MCP door is opened.
2. Control Device Identification: MCP component identification shall be provided so that all relays, timers, starters, overloads, fuses, etc. can be readily identified when the MCP door is opened. In addition to all prime manufacturers' nameplates, all electrical and mechanical control items mounted in or on panels or pushbutton stations shall be further identified in the system by permanently attached corrosion proof, etched, engraved, or stamped identification plates. Dymo type labels are not acceptable.
3. Enclosure:
 - a. All motor control panels and surface mounted control station enclosures shall be NEMA Type 12, except those exposed to direct rain, which shall be Type 3 or 4 Weatherproof. Panels shall be Hoffman or approved equal.

4. Main Power Shutoff:

- a. Fused Shutoff: Shall be a heavy duty, 3600Volts, 3 Phase, fused switch. Shutoff shall be General Electric, Allen-Bradley, or approved equal. Fuses shall be up to 600A - RK1 fuses. Shutoff shall be installed inside housing with operating handle arranged for connect or disconnect with doors of control panel in closed position. Size for added 30% code motor load.
- b. Circuit Breaker Shutoff: Shall be 3-pole, 460-volt, molded case, sizes as shown, 65,000 A.I.C. symmetrical at 360 volts AC. Provide SPDT auxiliary switch on each branch circuit breaker. Install main breaker with operator through and interlock with panel door. Main circuit breaker shall be G.E. Digital, Solid-State Spectra RMS Breakers or approved equal, sized for the associated panel with required spare capacity factored in. Circuit Breaker Frame minimum size is 150 Amp. Frame sizes are 150 Amp, 250 Amp, or 400 Amp and sized appropriately for the load. Full Load Amps can only be a maximum of 80% of the circuit breaker amperage size, until circuit breaker frame size is 400 Amp, where full load amps can be up to 100% of the circuit breaker amperage size. Loads less than or equal to 120AT shall be SELA series (150AF) with 80% UL Rating factored into the load for the main circuit breaker. Loads greater than 120AT and less than 200AT shall be SFLA series (250AF) with 80% UL Rating factored into the load for the main circuit breaker. Loads greater than 200AT shall be SGLL or SKLL series (400AF or 600AF) with 100% UL Rating for the main circuit breaker. For circuit breakers requiring a maximum limit of 80% Full Load Amps, it is recommended that the size of the rating plugs be provided at the 80% limit to help prevent the Full Load Amps from exceeding the 80% limit.

5. Motor Circuit Protectors:

- a. Motor circuit protectors shall be Magnetic Only Motor Circuit Protectors, 460Volts, 3-Pole, 15,000 A.I.C. minimum, and sized as required for intended load. For each motor, provide G.E. Spectra MAG-BREAK SE150 or approved equal, with amp rating plugs to match FLA rating of motor. Provide a shunt trip for VFDs when external Dynamic Brake Resistor is required. Circuit protectors shall be General Electric, Westinghouse, or approved equal. Circuit breakers shall coordinate with RK1 fuses or circuit breaker in main and shall be an UL approved coordination.

6. NEMA Starters:

- a. NEMA Starters: Motor starters shall be NEMA Rated, 3-Pole, 480V, 120V Starter Coil Voltage, magnetic across-the-line contactors, each with a holding contact and auxiliary contacts as required. Motor starters shall each have three manual-reset, thermal-overload relays. Reversing motor starters shall be Allen-Bradley 505 Series or approved equal and shall have electrical and mechanical interlocks. Starters shall incorporate thermal overload protection in all phases. Overload shall be set at 100%. Minimum starter size shall be NEMA size "0". All motor starters shall be mounted in Motor Control Panels with their associated controls.

7. Group Fusing for IEC Starters:

- a. Group Fusing: Fuse blocks shall be rated for 600Volt, 3-Pole, and sized as required for intended load. Fuse blocks shall be Gould Shawmut, Marathon, or approved equal. Fuse block, fuses, and associated components shall coordinate with RK1 fuses or circuit breaker in main and IEC starter, and shall be an UL approved coordination. Components and installation shall comply with NEC or Local Code requirements, whichever are more stringent.

- b. IEC Starters:
 - 1) Motor starters shall be UL approved for group motor installations and protected by group fusing in accordance with UL and NEC requirements. Short circuit protective device size shall comply with NEC requirements for group motor installations of this type. Starters shall be 3-Pole, 380V, 120/240V Starter Coil Voltage, with auxiliary contacts as required. Installation shall conform to NEC requirements. All motor starters shall be mounted in Motor Control Panels with their associated controls.
- 8. Relays:
 - a. Control Relays: Shall have a 120/240-volt AC coil rating, and each relay shall have a minimum of eight NO/NC contacts rated at 600 volts, 10 amps. surge suppressors on control relays.
 - b. Fire Alarm Interface Control Relay: Relay socket shall accept both 120/240VAC and 24VDC relays to allow flexibility for future interface.
 - c. All timing functions shall be accomplished in the programming. Timer relays are not acceptable, unless specifically required for an operation.
- 9. Pushbuttons, Selector Switches, Pilot Lights:
 - a. Pushbutton Stations: Pushbutton control stations shall be "Type 800T" switches and indicators or approved equal. All pushbutton stations in public view shall be flush mounted with stainless steel cover plates. Adequate maintenance access is required at all control stations.
- 10. Wire Trough:
 - a. Snap-in, slot-type, plastic units, removable rigid vinyl cover. Panduit Wiring Duct, E-type; or equal.
- 11. Programmable Logic Controllers:
 - a. System shall have Processor with 20% spare memory minimum, 120/240 volts AC Power Supply input, 6 month minimum battery backup for memory, 20% spare I/O capacity minimum, remote I/O communications capability, peer to peer communications, interface to fiber optic and broadband communication networks for airport wide connectivity capability, communication port configured for programming or user defined ASCII connection, low voltage and 120/240 volt I/O Modules, Programmer unit, Mounting Bases, and all appurtenant equipment necessary for a complete operating system. Systems shall be Allen Bradley ControlLogix/1756 System with Logix7x Processor, Siemens S7 series, Square D Modicon Quantum series, GE Fanuc series 90 30, Omron Sysmac CS1D Duplex System, or approved equal.
 - b. Data communications highway (DCH) shall be EtherNet/IP, ProfiNet/ProfiBus, or approved equal.
- 12. Terminal Blocks:
 - a. Shall be Allen Bradley 1492 Series, Style H or approved equal with white marking surface. Provide 20% spare capacity in terminal strips. Terminals shall be used as contact points for system operation and interface with other systems. Identify each contact for its system or interface connection.

13. Transformers:

- a. 480/120/240 volt, Single Phase, 60 Hz, size with 15% spare capacity, dry type, core and coil type transformer with terminal board and secondary fuse kit.

14. System Maps:

- a. Provide and install Mylar Conveyor overviews on the front face of control panels.

15. 24VDC Power Supplies:

- a. Input – 120/240Vac; Output - 24Vdc, 1.2 amps; Line Regulation - +/- .05% for 10% input change; Load Regulation - +/- .05% for 50% load change; Output Ripple - 3mv + .05% of output voltage peak-to-peak maximum; Remote Sensing - overload protection at 3 amperes; Temperature 0 degrees C - 90 degrees C.

1) Manufacturer shall be Condor DC power supplies or approved equal.

16. Operator Interface Terminal (OIT):

- a. Refer to section 2.8.P. for requirements.

17. Power Filters:

- a. Control Power: Power filter(s) shall be provided for each MCP to protect the PLC and remote base from power surges and outages. One or more of the power filters in each motor control panel shall also protect the message center, DC Power Supplies, and VFDs. Multiple PLC's, remote bases, or other power filter required equipment within a MCP can be filtered by one power filter, provided that the load is within the rating of the power filter. If the load is greater than the rating, multiple power filters shall be provided.
- b. VFD 480 VAC – 3 Phase Power: Power filter shall be by Innovative Technology, Inc. (IT Protector) or approved equal and sized appropriately to filter the 480VAC, 3 Phase power to the VFD's. Power filter units shall be coordinated with the VFD manufacturer. "NN400" version units are used for all "Delta" and "Un-Bonded Wye" applications. In both "Delta" and "Un-Bonded Wye" cases, a "Wye" TVSS unit will be severely damaged in the event of a ground fault. Terminating the neutral to the grounding part in the MCP when the fourth wire is not pulled to the panel is recommended by the local supplier, but it shall be verified by the Contractor with the supplier or manufacturer. The power filter shall be provided upstream of the VFD's and shall filter the power to all of the VFD's in the panel to protect the VFD's and fuses. If the load is greater than the power filter rating, multiple power filters shall be provided. The VFD power filter alarm contacts shall be monitored by SCS Fault Monitoring and the flush mounting kit shall not be used.

18. Soft Starts:

- a. Provide soft start controllers as necessary.

19. Fluorescent Lighting:

- a. Provide a florescent light fixture for every two bays of the motor control panel. Fixture type and size shall be coordinated with the motor control panel and mounted in the top of the panel. It shall not prevent easy maintenance access of any controls or other components in the panel. Provide a

door switch inside the panel to control the light fixture. Locate on the main panel door. Single pole switches shall be rated 20 amps at 120/277 volts.

20. GFI Duplex:

- a. Provide a duplex outlet in the panel for power to a laptop or programming module for programming of the PLC. Outlet shall not be used for operating power tools or non-programming activities. Receptacles shall be of specification grade and shall be Duplex 20-amp, 120-volt, 2-poled, 3-wire, Ivory color, GE 5262 or approved equal.
- b. Provide a Duplex Outlet with Cat 5e Ethernet Access on the exterior side of the door to the motor control panel. Type shall be Hubbell "Panel Safe 20A 125V GFCI with In-Cabinet Receptacle and Cat 5e Ethernet Access – PR205E" or approved equal.

21. Engraved Chart:

- a. New enclosure shall have an engraved chart illustrating fuse and heater ratings.

22. Labeling:

- a. Each component in the MCP will be labeled with an identifying phenolic label.

23. Power Distribution Blocks:

- a. 600V, 3 pole, Allen-Bradley, Model 1492 or approved equal.

24. Three Phase Voltage Source and Phase Reversal Protection:

- a. Provide monitoring for protection against loss of three phase voltage source and phase reversal. Signal from relay shall shut the associated baggage system down and identify a fault condition in the fault monitoring system.

25. Future Equipment:

- a. All baggage system motor control panels shall be designed for "future" equipment. Based on the available space in the control panel, panel builder shall determine the type and amount of future equipment. As an example, future motor circuit equipment shall be arranged as a logical continuation of the current circuits as space permits, extend the control relay mounting rail as space permits for future control relays, etc. Control panel back plane shall be drilled and tapped as required for all future equipment. Electrical/controls drawings shall identify the location of future equipment.

2.6.C. Variable Frequency Drives (VFD):

1. General: VFDs shall be rated to match the motor being served. Thermal overload protection of the motors shall be provided in the VFD and the settings shall be field adjusted using the VFD's internal parameters. Drives, at a minimum, shall be as follows:
 - a. All VFDs shall be provided from a single manufacturer.
 - b. Drive shall be solid-state variable-speed controllers which convert 50/60 Hz AC line to a variable frequency, variable voltage AC output suitable for control of a standard NEMA Design B induction

motor (inverter ready or duty) over a 10:1 speed range. Assembly shall comply with testing to UL Standard 508/60947-4 and be UL or ETL listed.

- c. Power line noise shall be limited to a 5% voltage distortion factor and line notch depth as defined in IEEE Standard 519 (latest edition).
- d. The VFD torque characteristic shall match the driven load.
- e. Power Input:
 - 1) Supply Voltage: 380 – 480 V $\pm$ 10%, 3-phase
 - 2) Supply Frequency: 50/60 Hz $\pm$ 2% tolerance.
 - 3) True Power Factor (λ) 0.92 Nominal at Rated Load.
 - 4) Displacement Power Factor ($\cos \phi$) (>0.98)
 - 5) Trip Levels: shall be +30%, -35% of nominal.
 - 6) Switching on Input Supply: 2 times/min.
- f. Power Output:
 - 1) Output Voltage: 10% – 100% of supply voltage, 3-phase.
 - 2) Output Amperes: Capacity shall meet or exceed the demand of drive motor based on full load current listed in the NEC Table 430-150 for the horsepower/kW provided.
 - 3) Output Frequency: 10% – 100% of supply Hz.
 - 4) Switching on Output: Unlimited
 - 5) Ramp Times: 0.01 – 3600 sec.
- g. Digital Inputs:
 - 1) Programmable Digital Inputs: 4 (6) Logic PNP or NPN
 - 2) Voltage Level: 0 – 24 V DC
 - 3) One/two digital inputs shall be capable of being programmed as digital outputs
- h. Analogue Inputs:
 - 1) Number of Analogue Inputs: 2
 - 2) Modes Voltage or Current
 - 3) Voltage Level: -10 to +10 V (scalable)
 - 4) Current Level: 0/4 – 20 mA (scalable)

- i. Pulse/Encoder Inputs:
 - 1) Programmable Pulse/Encoder Inputs: 2
 - 2) Voltage Level: 0 – 24 V DC (PNP positive logic)
- j. Digital Output:
 - 1) Programmable Digital/Pulse Outputs: 2
 - 2) Voltage Level at Digital/Frequency Output: 0 – 24 V
- k. Analogue Output:
 - 1) Programmable Analogue Outputs: 1
 - 2) Current Range: 0/4 – 20 mA
- l. Relay Outputs:
 - 1) Programmable Relay Outputs: 2
 - 2) Integrated 24 V Supply:
 - 3) Max. Load: 600 mA
- m. Ambient Operating Conditions:
 - 1) Environment: Temperature, 0-40 degrees C; Relative Humidity, 0-95%, non-condensing.
 - 2) Altitude: Heat Dissipation features shall adequately provide for effects of project site altitude on the effectiveness of required cooling, with no sacrifice of required power output.
- n. Enclosure shall be NEMA 1/IP10 for interior conditions and NEMA 4X/IP66 for exterior conditions.
- o. VFDs shall be provided with dynamic brake resistors sized for the application and the driven load.
- p. Fieldbus:
 - 1) EtherNet/IP, ProfiNet, Profibus DP, or approved equal.
- q. Variable Frequency Drives shall be Allen-Bradley “Power Flex 40”; Telemecanique “Altivar 31”; Hitachi, Model SJ100; or approved equal. Drive shall be coordinated with the motor for the specific application and housed in a NEMA rated motor control panel.
- 2. VFD for EDS Interface Requirements: VFD operation shall be in accordance with EDS Manufacturer’s requirements.
- 3. VFD for Vertical Sorter Requirements: VFD operation shall be in accordance with Vertical Sorter Manufacturer’s requirements.

2.6.D. Control Stations:

1. Control stations shall be multi pushbutton/selector station with labels for each operation. Enclosure shall be a NEMA type 4/13 pushbutton station, or approved equal. All control stations other than START and E STOP stations for conveyor sections in public view shall be located on adjacent conveyor sections out of public view and labeled for the conveyor section being controlled.

2.6.E. Disconnect Switches:

1. At each motor provide a heavy duty, 380V, 3 Phase, NEMA 1 Disconnect Switch with auxiliary contact to report status of disconnect to PLC for system monitoring. For motors with clutch/brakes, the disconnect shall shut off motor and clutch/brake simultaneously and have an auxiliary contact to report status of disconnect to PLC for system monitoring. Disconnects and assembly shall be lockable, UL listed, and comply with NEC or Local Code requirements, whichever are more stringent. Mount motor disconnect switch on trunk of conveyor below belt line adjacent to motor. Label disconnect switch with black phenolic, white incised identification label.
2. Disconnect Switches for Motors with VFDs: For motors with VFDs, provide a disconnect switch with a "Break before Main Break" auxiliary contact to signal VFD activate "Coast to Stop" operation to safely shut down the VFD prior to the motor being disconnected. For motors/VFDs not requiring a quick disconnect, type shall be Hubbell "Circuit-Lock HBLDS3VFD Disconnect with Early Break Auxiliary Contacts" or approved equal.
3. Quick Disconnect Switches for Motors with VFDs: For motors with VFDs, provide a disconnect switch with a "Break before Main Break" auxiliary contact to signal VFD activate "Coast to Stop" operation to safely shut down the VFD prior to the motor being disconnected. For motors/VFDs requiring a quick disconnect, type shall be Hubbell "Circuit-Lock HBL2430SW Disconnect with Early Break Auxiliary Contacts" or approved equal.

2.6.F. Uninterruptible Power Supply (UPS):

1. Provide one UPS to provide a minimum of 15 minutes of power to the PLCs during a power outage, prior to emergency power activation. Unit shall be type manufactured by Square D Company, Sola Corporation, Best Power model Ferrups, or equal. Each UPS shall have a maintenance bypass switch.

2.6.G. Electrical Power Conditioners:

1. The Contractor shall provide power regulators, as required, to ensure that the power to the control systems is properly conditioned. Regulators shall be manufactured by Square D Company, Sola Corporation, Best Power model Ferrups, or equal.

2.7 DISTRIBUTED ELECTRICAL AND LOW LEVEL CONTROLS COMPONENTS:

2.7.A. General:

1. Materials shall be of the quality specified herein, new, free from defects, of the best commercial/industrial grade, and approved by a nationally recognized testing laboratory wherever published standards exist. Each type of material shall be of the same make and manufacturer throughout the project. Materials shall comply with NEC or Local Code requirements, whichever are more stringent.
2. The electrical equipment identified herein is based on products by different manufacturers and indicates the level of quality and performance required for the equipment. Provided that the equipment is equal

in quality and performance to that identified herein and meets the requirements of these contract documents, electrical equipment by Allen Bradley, Siemens, Schneider Electric/Square D, Cutler Hammer, General Electric, Westinghouse, or approved equal is acceptable for use in this Work.

3. Contractor shall provide either NEMA or IEC components, as listed herein, but shall provide either NEMA or IEC components for any type of component throughout the Work (no intermixing of components), unless noted otherwise or with approval by the Owner or OAR.

2.7.B. Enclosures and Internal Components:

1. General:

- a. Panels shall be designed and arranged by a control company with a minimum history of 5 years experience of previous work in conveyor systems. Control panels shall be provided fully designed and manufactured ready to install for field connected wiring. Baggage System Contractor shall install panels secured to floor to withstand earthquake conditions of 1.5 times panel force. Provide fluorescent light fixture(s) inside each motor control panel to properly light electrical equipment and tagging, which shall turn on when MCP door is opened.

2. Control Device Identification: MCP component identification shall be provided so that all relays, timers, starters, overloads, fuses, etc. can be readily identified when the MCP door is opened. In addition to all prime manufacturers' nameplates, all electrical and mechanical control items mounted in or on panels or pushbutton stations shall be further identified in the system by permanently attached corrosion proof, etched, engraved, or stamped identification plates. Dymo type labels are not acceptable.

3. 24VDC Power Supplies:

- a. Input - 120Vac; Output - 24Vdc, 1.2 amps; Line Regulation - +/- .05% for 10% input change; Load Regulation - +/- .05% for 50% load change; Output Ripple - 3mv + .05% of output voltage peak-to-peak maximum; Remote Sensing - overload protection at 3 amperes; Temperature 0 degrees C - 90 degrees C.
- b. Manufacturer shall be Condor DC power supplies or approved equal.

4. Relays:

- a. Control Relays: Shall have a 120-volt AC coil rating, and each relay shall have a minimum of eight NO/NC contacts rated at 600 volts, 10 amps. Allen-Bradley Model 700, Type P800. Provide surge suppressors on control relays.
- b. Fire Alarm Interface Control Relay: Relay socket shall accept both 120VAC and 24VDC relays to allow flexibility for future interface. Relay socket shall be Allen-Bradley Model 700-HN128 or equal. Relay shall be Allen-Bradley Model 700-HC or equal.
- c. All timing functions shall be accomplished in the programming. Timer relays are not acceptable, unless specifically required for an operation.

5. Pushbuttons, Selector Switches, Pilot Lights:

- a. Pushbutton Stations: Pushbutton control stations shall be Allen Bradley Type 800T switches and indicators or approved equal. All pushbutton stations in public view shall be flush mounted with stainless steel cover plates. Adequate maintenance access is required at all control stations.

6. Wire Trough:

- a. Snap-in, slot-type, plastic units, removable rigid vinyl cover. Panduit Wiring Duct, E-type; or equal.

7. Terminal Blocks:

- a. Shall be Allen Bradley 1492 Series, Style H or approved equal with white marking surface. Provide 20% spare capacity in terminal strips. Terminals shall be used as contact points for system operation and interface with other systems. Identify each contact for its system or interface connection.

8. Fluorescent Lighting:

- a. Provide a florescent light fixture for every two bays of the motor control panel. Fixture type and size shall be coordinated with the motor control panel and mounted in the top of the panel. It shall not prevent easy maintenance access of any controls or other components in the panel. Provide a door switch inside the panel to control the light fixture. Locate on the main panel door. Single pole switches shall be rated 20 amps at 120/277 volts.

9. Engraved Chart:

- a. New enclosure shall bare an engraved chart illustrating fuse and heater ratings.

10. Labeling:

- a. Each component in the MCP will be labeled with an identifying phenolic label.

11. Soft Starts:

- a. Provide soft start controllers as necessary. Type shall be Allen Bradley, General Electric, Motortronics, or approved equal.

2.7.C. Motor Control Panels:

1. Enclosure:

- a. All motor control panels and surface mounted control station enclosures shall be NEMA Type 12 (IP52), except those exposed to direct rain, which shall be NEMA Type 3 or 4 (IP54 or IP66) Weatherproof. Panels shall be Hoffman or approved equal.

2. Main Power Shutoff:

- a. Fused Shutoff: Shall be a heavy duty, 480Volts, 3 Phase, fused switch. Shutoff shall be General Electric, Allen-Bradley, or approved equal. Fuses shall be up to 600A - RK1 fuses. Shutoff shall be installed inside housing with operating handle arranged for connect or disconnect with doors of control panel in closed position. Size for added 30% code motor load.
- b. Circuit Breaker Shutoff: Shall be 3-pole, 480-volt, molded case, sizes as shown, 65,000 A.I.C. symmetrical at 480 volts AC. Provide SPDT auxiliary switch on each branch circuit breaker. Install main breaker with operator through and interlock with panel door. Main circuit breaker shall be G.E. Digital, Solid-State Spectra RMS Breakers or approved equal, sized for the associated panel with required spare capacity factored in. Circuit Breaker Frame minimum size is 150 Amp. Frame sizes are 150 Amp, 250 Amp, or 400 Amp and sized appropriately for the load. Full Load Amps

can only be a maximum of 80% of the circuit breaker amperage size, until circuit breaker frame size is 400 Amp, where full load amps can be up to 100% of the circuit breaker amperage size. Loads less than or equal to 120AT shall be SELA series (150AF) with 80% UL Rating factored into the load for the main circuit breaker. Loads greater than 120AT and less than 200AT shall be SFLA series (250AF) with 80% UL Rating factored into the load for the main circuit breaker. Loads greater than 200AT shall be SGLL or SKLL series (400AF or 600AF) with 100% UL Rating for the main circuit breaker. For circuit breakers requiring a maximum limit of 80% Full Load Amps, it is recommended that the size of the rating plugs be provided at the 80% limit to help prevent the Full Load Amps from exceeding the 80% limit.

3. Motor Circuit Protectors:

- a. Motor circuit protectors shall be Magnetic Only Motor Circuit Protectors, 480Volts, 3-Pole, 15,000 A.I.C. minimum, and sized as required for intended load of five to six motors maximum. Provide G.E. Spectra MAG-BREAK SE150 or approved equal, with amp rating plugs to match FLA rating of motor. Circuit protectors shall be General Electric, Westinghouse, or approved equal. Circuit breakers shall coordinate with RK1 fuses or circuit breaker in main and shall be an UL approved coordination.

4. Group Fusing for IEC Starters:

- a. Group Fusing: Fuse blocks shall be rated for 600Volt, 3-Pole, and sized as required for intended load. Fuse blocks shall be Gould Shawmut, Marathon, or approved equal. Fuse block, fuses, and associated components shall coordinate with RK1 fuses or circuit breaker in main and IEC starter, and shall be an UL approved coordination. Components and installation shall comply with NEC or Local Code requirements, whichever are more stringent.

5. Transformers:

- a. 480/120 volt, Single Phase, 60 Hz, size with 15% spare capacity, dry type, core and coil type transformer with terminal board and secondary fuse kit. General Electric 9T5B 60 and 70 series, Acme Electric Corp., or approved equal.

6. System Maps:

- a. Provide and install Mylar Conveyor overviews on the front face of control panels.

7. Power Filters:

- a. VFD 480 VAC – 3 Phase Power: Power filter shall be by Innovative Technology, Inc. (IT Protector) or approved equal and sized appropriately to filter the 480VAC, 3 Phase power to the VFD's. Power filter units shall be PTX065 series, PTX080 series, or equivalent, and coordinated with the VFD manufacturer. "NN400" version units are used for all "Delta" and "Un-Bonded Wye" applications. In both "Delta" and "Un-Bonded Wye" cases, a "Wye" TVSS unit will be severely damaged in the event of a ground fault. Terminating the neutral to the grounding part in the MCP when the fourth wire is not pulled to the panel is recommended by the local supplier, but it shall be verified by the Contractor with the supplier or manufacturer. The power filter shall be provided upstream of the VFD's and shall filter the power to all of the VFD's in the panel to protect the VFD's and fuses. If the load is greater than the power filter rating, multiple power filters shall be provided. The VFD power filter alarm contacts shall be monitored by SCS Fault Monitoring and the flush mounting kit shall not be used.

8. Power Distribution Blocks:

- a. 600V, 3 pole, Allen-Bradley, Model 1492 or approved equal.

9. Three Phase Voltage Source and Phase Reversal Protection:

- a. Provide monitoring for protection against loss of three phase voltage source and phase reversal. Signal from relay shall shut the associated baggage system down and identify a fault condition in the fault monitoring system. Monitors shall be Allen-Bradley “Solid-State Line Voltage and Current Monitor Relays (Bulletin 813S)”, Square D “Phase Failure Relays (Class 8430 – Type MP)”, or approved equal.

10. Future Equipment:

- a. All baggage system motor control panels shall be designed for "future" equipment. Based on the available space in the control panel, panel builder shall determine the type and amount of future equipment. As an example, future motor circuit equipment shall be arranged as a logical continuation of the current circuits as space permits, extend the control relay mounting rail as space permits for future control relays, etc. Control panel back plane shall be drilled and tapped as required for all future equipment. Electrical/controls drawings shall identify the location of future equipment.

2.7.D. Distribution Panels:

1. Enclosure:

- a. All distribution panels shall be NEMA Type 12 (IP52), except those exposed to direct rain, which shall be NEMA Type 3 or 4 (IP54 or IP66) Weatherproof.

2.7.E. Motor Circuit Breaker Boxes:

1. Enclosure:

- a. Motor circuit breaker box enclosures shall be NEMA Type 4 (IP66) Weatherproof. Panels shall have a window and shall be Hoffman or approved equal. Unit shall be located on side of the conveyor within six feet of the motor starter and drive unit.

2. Miniature Circuit Breakers:

- a. Provide miniature circuit breakers 480Volts, 3-Pole, 15,000 A.I.C. minimum, and sized as required for intended load. For VFDs, provide miniature circuit breakers with a “Break before Main Break” auxiliary contact to signal VFD activate “Coast to Stop” operation to safely shut down the VFD prior to the motor being disconnected within the enclosure. Provide a shunt trip for VFDs when external Dynamic Brake Resistor is required. Miniature circuit breakers shall be by Allen-Bradley, Eaton, Schneider Electric, or approved equal. Miniature circuit breakers shall coordinate with RK1 fuses or circuit breaker in main and shall be an UL approved coordination.

2.7.F. PLC Panels:

1. Enclosure:

- a. All PLC panels shall be a free standing panel with a large transparent panel in each door and shall be by Hoffman or approved equal.

2. Programmable Logic Controllers:

- a. System shall have Processor with 20% spare memory minimum, 120 volts AC Power Supply input, 6 month minimum battery backup for memory, 20% spare I/O capacity minimum, remote I/O communications capability, peer to peer communications, interface to fiber optic and broadband communication networks for airport wide connectivity capability, communication port configured for programming or user defined ASCII connection, low voltage and 120 volt I/O Modules, Programmer unit, Mounting Bases, and all appurtenant equipment necessary for a complete operating system. Systems shall be Allen Bradley ControlLogix/1756 System with Logix7x Processor, Siemens S7 series, Square D Modicon Quantum series, GE Fanuc series 90 30, Omron Sysmac CS1D Duplex System, or approved equal. Data communications highway (DCH) shall be Ethernet/IP, Allen Bradley "ControlNet", Square D "Modbus", GE Fanuc "Genius LAN", Profibus, Omron Controller Link/Sysmac Link, or approved equal.

3. Uninterruptible Power Supply:

- a. Provide one UPS to provide a minimum of 15 minutes of power to the PLCs during a power outage, prior to emergency power activation. Unit shall be type manufactured by Square D Company, Sola Corporation, Best Power model Ferrups, or equal. Each UPS shall have a maintenance bypass switch.

4. Power Filters:

- a. Control Power: Power filter shall be an Innovative Technology, Inc. model number HS-P-SP-120-30A-RJ or approved equal. Power filter(s) shall be provided for each MCP to protect the PLC and remote base from power surges and outages. One or more of the power filters in each motor control panel shall also protect the message center, DC Power Supplies, and VFDs. Multiple PLC's, remote bases, or other power filter required equipment within a MCP can be filtered by one power filter, provided that the load is within the rating of the power filter. If the load is greater than the rating, multiple power filters shall be provided.

5. GFI Duplex:

- a. Provide a duplex outlet in the panel for power to a laptop or programming module for programming of the PLC. Outlet shall not be used for operating power tools or non-programming activities. Receptacles shall be of specification grade and shall be Duplex 20-amp, 120-volt, 2-poled, 3-wire, Ivory color, GE 5262 or approved equal.
- b. Provide a Duplex Outlet with Cat 5e Ethernet Access on the exterior side of the door to the motor control panel. Type shall be Hubbell "Panel Safe 20A 125V GFCI with In-Cabinet Receptacle and Cat 5e Ethernet Access – PR205E" or approved equal.

2.7.G. Distributed I/O Panels:

1. Enclosure:

- a. All distributed I/O panel enclosures with window in the door shall be NEMA Type 12 (IP52), except those exposed to direct rain, which shall be NEMA Type 3 or 4 (IP54 or IP66) Weatherproof. Panels shall be Hoffman, Cooper/B-Line, or approved equal.

2. Distributed I/O:

- a. Provide I/O unit compatible with and manufactured by the PLC manufacturer used on the project. Systems shall be by Allen Bradley, Square D, GE, Omron, or approved equal.

2.7.H. Motor Starters:

1. Custom Motor Starter Panels:

a. NEMA Starters:

- 1) All NEMA starters shall be Allen-Bradley 509 Series or approved equal. Motor starters shall be NEMA Rated, 3-Pole, 480V, 120V Starter Coil Voltage, magnetic across-the-line contactors, each with a holding contact and auxiliary contacts as required. Motor starters shall each have three manual-reset, thermal-overload relays. Reversing motor starters shall be Allen-Bradley 505 Series or approved equal and shall have electrical and mechanical interlocks. Starters shall incorporate thermal overload protection in all phases. Overload shall be set at 100%. Minimum starter size shall be NEMA size “0”. Motor starter shall be coordinated with the motor for the specific application and mounted on the side of the conveyor in a panel near the motor.

b. IEC Starters:

- 1) All IEC starters shall be TeSys U series starters with “D-Line” series contactors, Allen-Bradley bulletin 190S DOL Compact series starters, or approved equal. Reversing motor starters shall be Allen-Bradley 191S Reversing Compact series, or approved equal. Motor starters shall be UL approved for group motor installations and protected by group fusing in accordance with UL and NEC requirements. Short circuit protective device size shall comply with NEC requirements for group motor installations of this type. Starters shall be 3-Pole, 480V, 120V Starter Coil Voltage, with auxiliary contacts as required. Installation shall conform to NEC requirements. Motor starter shall be coordinated with the motor for the specific application and mounted on the side of the conveyor in a panel near the motor.

2. Consolidated Motor Starters:

- a. If a custom motor starter panel is not used, provide a consolidated motor starter for each motor. Starter shall be coordinated with the motor for the specific application and mounted on the side of the conveyor near the motor. Motor starters shall be SEW Eurodrive, Model Movimot; Allen-Bradley “ArmorStart Motor Controllers”; or approved equal.

2.7.I. Variable Frequency Drives (VFD):

- 1. General: VFDs shall be rated to match the motor being served. Thermal overload protection of the motors shall be provided in the VFD and the settings shall be field adjusted using the VFD’s internal

parameters. Drive unit shall be of decentralized design consisting of VFD, motor circuit protector, safety disconnecting means, local control switches and pushbuttons NEMA/IP rated enclosure and associated controls. Drives, at a minimum, shall be as follows:

- a. All VFDs shall be provided from a single manufacturer.
- b. Drive shall be solid-state variable-speed controllers which convert 50/60 Hz AC line to a variable frequency, variable voltage AC output suitable for control of a standard NEMA Design B induction motor (inverter ready or duty) over a 10:1 speed range. Assembly shall comply with testing to UL Standard 508/60947-4 and be UL or ETL listed.
- c. Power line noise shall be limited to a 5% voltage distortion factor and line notch depth as defined in IEEE Standard 519 (latest edition).
- d. The VFD torque characteristic shall match the driven load.
- e. Power Input:
 - 1) Supply Voltage: 380 – 480 V $\pm$ 10%, 3-phase
 - 2) Supply Frequency: 50/60 Hz +/- 2% tolerance.
 - 3) True Power Factor (λ) 0.92 Nominal at Rated Load.
 - 4) Displacement Power Factor ($\cos \phi$) (>0.98)
 - 5) Trip Levels: shall be +30%, -35% of nominal.
 - 6) Switching on Input Supply: 2 times/min.
- f. Power Output:
 - 1) Output Voltage: 10% – 100% of supply voltage, 3-phase.
 - 2) Output Amperes: Capacity shall meet or exceed the demand of drive motor based on full load current listed in the NEC Table 430-150 for the horsepower/kW provided.
 - 3) Output Frequency: 10% – 100% of supply Hz.
 - 4) Switching on Output: Unlimited
 - 5) Ramp Times: 0.01 – 3600 sec.
- g. Digital Inputs:
 - 1) Programmable Digital Inputs: 4 (6) Logic PNP or NPN
 - 2) Voltage Level: 0 – 24 V DC
 - 3) One/two digital inputs shall be capable of being programmed as digital outputs

- h. Analogue Inputs:
 - 1) Number of Analogue Inputs: 2
 - 2) Modes Voltage or Current
 - 3) Voltage Level: -10 to +10 V (scalable)
 - 4) Current Level: 0/4 – 20 mA (scalable)
- i. Pulse/Encoder Inputs:
 - 1) Programmable Pulse/Encoder Inputs: 2
 - 2) Voltage Level: 0 – 24 V DC (PNP positive logic)
- j. Digital Output:
 - 1) Programmable Digital/Pulse Outputs: 2
 - 2) Voltage Level at Digital/Frequency Output: 0 – 24 V
- k. Analogue Output:
 - 1) Programmable Analogue Outputs: 1
 - 2) Current Range: 0/4 – 20 mA
- l. Relay Outputs:
 - 1) Programmable Relay Outputs: 2
- m. Integrated 24 V Supply:
 - 1) Max. Load: 600 mA
- n. Ambient Operating Conditions:
 - 1) Environment: Temperature, 0-40 degrees C; Relative Humidity, 0-95%, non-condensing.
 - 2) Altitude: Heat Dissipation features shall adequately provide for effects of project site altitude on the effectiveness of required cooling, with no sacrifice of required power output.
- o. Enclosure shall be NEMA 1/IP10 for interior conditions and NEMA 4X/IP66 for exterior conditions.
- p. VFDs shall be provided with dynamic brake resistors sized for the application and the driven load.
- q. Fieldbus:
 - 1) EtherNet/IP, ProfiNet, ProfiBus DP, or approved equal.

- r. Consolidated Decentralized Motor Starter/VFD: Variable Frequency Drives shall be SEW Eurodrive, Model Movimot; Allen-Bradley “ArmorStart Motor Controllers”; Danfoss “VLT”; or approved equal. Drive shall be coordinated with the motor for the specific application and mounted on the side of the conveyor near the motor.
 - s. Individual Decentralized Motor Starter/VFD: If a consolidated motor starter/VFD is not used, Variable Frequency Drives shall be Allen-Bradley “Power Flex 40”; Telemecanique “Altivar 31”; Hitachi, Model SJ100; or approved equal. Drive shall be coordinated with the motor for the specific application and housed in a NEMA rated custom motor starter panel with the individual motor starter on the side of the conveyor near the motor.
- 2. VFD for EDS Interface Requirements: VFD operation shall be in accordance with EDS Manufacturer’s requirements.
 - 3. VFD for Vertical Sorter Requirements: VFD operation shall be in accordance with Vertical Sorter Manufacturer’s requirements.

2.7.J. Disconnect Switches:

- 1. At each motor provide a heavy duty, 480V, 3 Phase, NEMA 1 Disconnect Switch with auxiliary contact to report status of disconnect to PLC for system monitoring. For motors with clutch/brakes, the disconnect shall shut off motor and clutch/brake simultaneously and have an auxiliary contact to report status of disconnect to PLC for system monitoring. Disconnects and assembly shall be lockable, UL listed, and comply with NEC or Local Code requirements, whichever are more stringent. Type shall be General Electric, Square D, Allen Bradley, Cutler Hammer, Westinghouse, or approved equal. Mount motor disconnect switch on trunk of conveyor below belt line adjacent to motor. Label disconnect switch with black phenolic, white incised ¾” letters.
- 2. Disconnect Switches for Motors with VFDs: For motors with VFDs, provide a disconnect switch with a “Break before Main Break” auxiliary contact to signal VFD activate “Coast to Stop” operation to safely shut down the VFD prior to the motor being disconnected. For motors/VFDs not requiring a quick disconnect, type shall be Hubbell “Circuit-Lock HBLDS3VFD Disconnect with Early Break Auxiliary Contacts” or approved equal.
- 3. Quick Disconnect Switches for Motors with VFDs: For motors with VFDs, provide a disconnect switch with a “Break before Main Break” auxiliary contact to signal VFD activate “Coast to Stop” operation to safely shut down the VFD prior to the motor being disconnected. For motors/VFDs requiring a quick disconnect, type shall be Hubbell “Circuit-Lock HBL2430SW Disconnect with Early Break Auxiliary Contacts” or approved equal.

2.7.K. Uninterruptible Power Supply (UPS):

- 1. Provide one UPS to provide a minimum of 15 minutes of power to the PLCs during a power outage, prior to emergency power activation. Unit shall be type manufactured by Square D Company, Sola Corporation, Best Power model Ferrups, or equal. Each UPS shall have a maintenance bypass switch.

2.7.L. Electrical Power Conditioners:

- 1. The Contractor shall provide power regulators, as required, to ensure that the power to the control systems is properly conditioned. Regulators shall be manufactured by Square D Company, Sola Corporation, Best Power model Ferrups, or equal.

2.8 SUPERVISORY HIGH LEVEL CONTROL SYSTEM EQUIPMENT:

2.8.A. General:

1. All computer/network system hardware shall be standard off the shelf components. Custom hardware or interface devices are not acceptable. The system shall be designed to operate satisfactorily within a temperature range of 50 degrees to 90 degrees F (10 degrees to 32 degrees C) with a relative humidity (non condensing) of 20% to 90%. A CD-RW/DVD-ROM unit shall be provided in each computer and server for program loading, program updates, and saving of current system updates. Program updates and transfer shall be accomplished through the CD-RW/DVD-ROM units or VPN connection. Interface with the PLC network shall be through Fast and/or Gigabit Ethernet, or other approved protocol. Interfaces with external devices, manual encoding stations, and remote computers/displays shall be through Fast and/or Gigabit Ethernet or other approved protocol. Supervisory Control System including computers, servers, and other associated equipment shall be capable of installation in standard 19" vertical rack frames. Provide a minimum of 20% spare memory. Hard drive space for each computer or server shall be capable of storing all necessary program software, applications, and achieves required for that computer or server and have sufficient spare capacity as recommended/required by the manufacturer. Computers, servers, and pertinent equipment shall be industrially hardened with the minimum requirements listed below. The minimum required hardware and software is as follows:

2.8.B. SHLCS Servers:

1. The minimum required hardware and software is as follows:
 - a. Processor: 64-bit x86 processors,8 Core, 3.0GHz, 15MB Cache, 7.2GT/s, 115W.
 - b. Additional Processor: 64-bit x86 processors,8 Core, 3.0GHz, 15MB Cache, 7.2GT/s, 115W.
 - c. Power Management BIOS Settings: Performance BIOS Settings.
 - d. Memory Capacity: 4 x 32GB RDIMM, Low Volt, Dual Rank, x4.
 - e. Memory DIMM Type and Speed: 1333 MHz RDIMMs.
 - f. Memory Configuration Type: Performance Optimized.
 - g. Chassis Configuration: 2.5" Chassis with up to 8 Hard Drives.
 - h. Hard Drives: (8) 300GB 15K RPM SAS 6Gbps 2.5in Hot-plug Hard Drive.
 - i. RAID Controller: SAS RAID Controller, 1GB Cache.
 - j. RAID Configuration: RAID 1 + RAID 5 (RAID 10).
 - k. Internal Optical Drive: DVD+/- RW, SATA, Internal.
 - l. PCIe Riser: Risers with up to 6, x8 PCIe Slots + 1, x16 PCIe Slot.
 - m. Embedded Systems Management.
 - n. Select Network Adapter: Ethernet 1Gb 4-port Network Adapter.

- o. Power Supply: Dual, Hot-plug, Redundant Power Supply (1+1), 750W.
 - p. Power Cord: (2) NEMA 5-15P to C13 Wall Plug, 125 Volt, 15 Amp, 10 Feet (3m), Power Cord.
 - q. Operating System: Windows Server (latest applicable version), Standard Edition, x64, Includes 5 CALS.
 - r. OS Media Kits: Windows Server (latest applicable version), Standard Edition, x64, Media Kit.
 - s. Microsoft SQL Server.
 - t. KepWare OPC Server.
 - u. Graphic Display Software.
 - v. Antivirus Software.
 - w. VNC software.
 - x. Rack Rail: Provide Sliding Rails with Cable Management Arm.
 - y. Bezel.
- 2.8.C. Virtual Machine (VM):
- 1. General: If the BHSC provides a VM solution, it shall comply the following minimum requirements:
 - a. VM Servers: Servers shall be as per section 2.8.B. - SHLCS Servers.
 - b. High Availability Virtualization Technology Software for hot backup redundancy. For the servers, provide high availability virtualization technology software synchronizing two standard windows servers to create a single windows application environment to achieve hot-backup redundancy with automatic and transparent switchover. This virtual server shall look and act like any other server, but shall have the resiliency of two physical servers providing redundancy. At a minimum, the servers shall be comprised of two similarly configured hardware and software components to provide redundancy.
 - 1) High Availability (HA) shall be 99.99% or greater.
 - c. Disaster Recovery (DR)
 - d. Sort Allocation Controller (SAC):
 - e. Sortation Controller (SC):
 - f. Maintenance Diagnostics System (MDS) Controller:
 - g. Supervisory Control and Data Acquisition (SCADA) Controller:
 - h. Management Information System (MIS) Controller:
 - i. Hypervisor:

- j. vSphere:

2.8.D. SCS Workstation Computers:

1. SCS Workstation Computers: The minimum required hardware and software is as follows:
 - a. Computers: Small Form Factor with up to 90% Efficient PSU.
 - b. Processors: 64-bit x86 processors, 8MB Cache, 3.4GHz.
 - c. Thermals: Heat Sink, Performance/Mainstream, Small Form Factor; or approved equal.
 - d. Memory: 16GB, NON-ECC, 1600MHz DDR4, 4DIMM.
 - e. Graphics Card: 1GB, LP, with VGA.
 - f. Boot Hard Drive: 500GB 3.5 SATA 6Gb/s with 16MB Cache.
 - g. Security Hardware: Chassis Intrusion Switch.
 - h. Removable Media Storage Device: 8X Slimline DVD+/-RW.
 - i. Network Card: Ethernet LAN 10/100/1000 Mbps Card with RJ45 Port.
 - j. Parallel Port Adapter, Low Profile.
 - k. Serial Port Adapter, Low Profile.
 - l. Power Supplies: Small Form Factor with up to 90% Efficient PSU.
 - m. Low Power Mode: 1 Watt ready low-power mode.
 - n. Keyboard: USB 104 Quiet Key Keyboard, English.
 - o. Mouse: USB Optical Mouse.
 - p. USB Ports: USB 3.0 Ports, backward compatible with 2.0 and 1.1.
 - q. Speakers.
 - r. Operating System: Genuine Windows® 10 Professional, No Media, 64-bit, English.
 - s. Productivity Software: Microsoft® Office Professional 365, English.
 - t. Antivirus Software.
 - u. PDF development and editing software.
 - v. VNC software.

2.8.E. Monitors:

1. Workstation monitors shall be, at a minimum, Two 24 Inch Monitor with Adjustable Stand, Wide Screen, VGA/DVI/DP, 1920 x 1080 Screen Resolution.
2. 42" System Status Display monitors shall be, at a minimum, 40" LED monitors, 1920 x 1080 resolution, 0.485 mm display pixel, 700 cd/m2 brightness, 1200:1 static and 300:1 dynamic contrast ratio, 178° horizontal and 178° vertical viewing angle, 9 ms typical response time, 1 HDMI, 1 VGA in, 1 VGA out, 2 DisplayPort, anti-static, anti-glare, plug and play, I/O ports, 120VAC, 32 deg. F to 104 deg. F (0 deg. C to 40 deg. C) with a relative humidity (non condensing) of 5% to 95% operating temperature.

2.8.F. Printers:

1. Printers shall be, at a minimum, laser printer, 1200 by 1200 DPI, 32 PPM, Ethernet Networked. Printers to be networked to the computers for printing reports and system status.

2.8.G. USB Ports:

1. All USB ports shall be USB 3.0 Ports and backward compatible with USB 2.0 and USB 1.1.

2.8.H. Software:

1. Provide standard off the shelf software wherever possible and beneficial to the Work. Operating platform software shall be as identified above or approved equal.

2.8.I. Network Switches:

1. Switches shall be managed, rack mountable with 24 Ethernet 10/100/1000BASE-T ports and 2 Small Form-Factor Pluggable (SFP) based Gigabit Ethernet fiber ports for 100/1000 Mbps connectivity, 2 HDMI ports on the rear of the unit (used for stacking only), automatic-sensing and automatic-negotiating capabilities for all copper ports, and automatic uplink on all ports to make the right connection. Switches shall be in a redundant configuration and shall be configured in coordination with the Airport's I.T. department, so that Airport networks are not impacted.

2.8.J. Network Firewalls:

1. Firewalls shall be rack mountable with 6 Ethernet 10/100/1000 Mbps ports, 1 Console Interface, 2 USB Ports; and Failover capability. Firewalls shall be in a redundant configuration and shall be configured in coordination with the Airport's I.T. department, so that Airport networks are not impacted. Firewalls shall be provided for outside network connections, such as VPN connections.

2.8.K. VPN Access:

1. VPN access shall be setup and routed through the firewalls.

2.8.L. IP Addressing:

1. IP address ranges shall be coordinated with the Owner prior to implementation.

2.8.M. Uninterruptible Power Supply (UPS):

1. Provide one UPS to provide a minimum of 15 minutes of power to the Supervisory Control System during a power outage, prior to emergency power activation. Each UPS shall have a maintenance bypass switch.

2.8.N. Electrical Power Conditioners:

1. The Contractor shall provide power regulators, as required, to ensure that the power to the control systems is properly conditioned.

2.8.O. Metal Rack Casework:

1. Vertical Frames: Provide standard 483 mm (19”) vertical rack frames complete with enclosure panels, doors, and trim. Finishes to be determined by the Owner or OAR. Contractor shall submit examples of finishes for approval. Quantities to be determined by Baggage System Contractor. Vertical frames enclosures shall be acceptable to the Owner or OAR. Refer to Baggage System Contract Drawings for extent of enclosures. Vertical rack shall have lockable doors on front and back of unit, and fan and exhaust unit with filters.
2. Workstation Frames: Provide workstations in the BHS Control Rooms and BHS Server Rooms consisting of desk height work surface and standard 483 mm (19”) rack frames complete with enclosure panels, doors, and trim. Finishes to be determined by the Owner or OAR. Contractor shall submit examples of finishes for approval. Quantities to be determined by Baggage System Contractor. Workstations shall be acceptable to the Owner or OAR. Refer to Baggage System Contract Drawings for extent of workstations. Rack frames shall have lockable doors on front and back of unit, and fan and exhaust unit with filters.

2.8.P. Baggage Status Displays:

1. Operator Interface Terminal (OIT):
 - a. Provide Integrated Display Computer, 15 inch, Touch Screen, TFT Color, Ethernet, 24V DC, Windows CE OS License. Refer to the Baggage System Contract Drawings for mounting requirements and locations. Refer to Description of Operations herein for operational requirements.
2. Baggage Removal Point BSD:
 - a. Provide a 304.8 mm (12”) minimum touch screen display. Unit shall be an Integrated LCD Touch Display Computer or LCD Touch Monitor with small form factor thin profile PC and mounting bracket. Refer to the Baggage System Contract Drawings for mounting requirements and locations. Refer to Description of Operations herein for operational requirements.
3. BSD for Baggage Inspection Table / Baggage Inspection Stations:
 - a. Provide a 381 mm (15”) minimum touch screen display. Unit shall be an Integrated LCD Touch Display Computer or LCD Touch Monitor with small form factor thin profile PC and mounting bracket. Refer to the Baggage System Contract Drawings for mounting requirements and locations. Refer to Description of Operations herein for operational requirements.

2.8.Q. Automated Bag Tag Reader Array (ATR):

1. Provide ATR arrays with 8 cameras (OCR) in a 270° scanning array above the conveyor and 2 laser scanners in a 90° scanning array below the conveyor for a total of 360° scanning array, minimum, with all equipment and components necessary for a complete bar code reader system capable of reading IATA bar code standards and requirements and/or user's bar code standards and requirements, as stated herein. Reader system shall interface with the sortation controllers to transfer information on bag tags to the sortation allocation controller. Readers shall be capable of determining a bag's sort code at a minimum rate of 60 bags per minute with expansion capability of 80 bags per minute.
2. The reader assembly shall consist of a frame containing 8 cameras with a minimum of 4 cameras optically encircling the conveyor and providing 270 degree read capability with the remaining cameras before and after the 4 cameras and overhead in line with the conveyor per the manufacturer's standard bag tag reader array configuration. The reader assembly shall also consist of 2 laser scanner heads, minimum, under the conveyor and providing 90 degree read capability per the manufacturer's standard bag tag reader array configuration. The 8 cameras plus the 2 laser scanner heads shall provide 360 degree scanning capability. The reader shall read a minimum of 95% of all bags under test conditions and 90% of all bags with originating tags under standard operating conditions for proper sortation to their intended destination under the circumstances that the quality of printed tags meets IATA and industry standards. Reader arrays shall be equipped with data reconstruction software. Controllers and photoeyes shall be redundant.
3. Automated Bag Tag Reader equipment shall be standard off the shelf components and capable of reading information on a baggage tag for standard baggage as defined herein within the width of the conveyor.
4. Code readers (OCR) shall be capable of reading bag tags conforming to IATA Resolution 740 and user's requirements and standards. The reader system shall meet IATA Recommended Practice 1740d. All bar codes will be USS Interleaved 2 of 5 for both IATA 10 Digit and user's 10 Digit bar code bag tags. System shall be video coding and OCR with software capable of properly reading the address information from the bag tag for identification when the bar code is not readable in a minimal amount of time.
5. Reader shall provide serial RS 232C, RS 422, and/or RS 485 port signal levels, bit serial ASCII data format, and baud rate between 300 and 115,200 baud; TCP/IP, FTP, Half/Full Duplex, 10 Mbits/s to 100 Mbits/s; and ProfiBus, 12 MBaud. Digital switching input – PNP, configurable, and short-circuit proof. Digital outputs – potential-free. Output data – customized data output string.
6. Individual scanner heads shall be capable of reading a tag having two bar codes oriented orthogonally bi-directional. Bags may have up to three (3) tags in order to provide the required routing information. Reader shall be capable of reading the tags and assimilate the data for use by the supervisory computer system.
7. Radio Frequency Identification (RFID) reader and antenna by ATR supplier shall be provided on the ATR assembly as recommended by the ATR supplier in quantities and locations shown on the BHS Contract Drawings and/or as described herein.

2.8.R. Baggage Measurement Array (BMA):

1. Baggage Measuring Array (BMA) by ATR supplier shall be provided on the ATR assembly as recommended by the ATR supplier in quantities and locations shown on the BHS Contract Drawings and/or as described herein.

2. Type shall be SICK ALIS, DataLogics, Cognex, or approved equal.

2.8.S. Radio Frequency Identification (RFID): NA

2.8.T. Manual Encoding Console: NA

2.9 SELF-BAG TAGGING (SBT):

2.9.A. General:

1. Provide Self-Bag Tagging (SBT) units in quantity and locations as shown on the BHS Contract Drawings and as specified herein. Unit shall be acceptable to the Owner and OAR prior to procurement and installation.

2.9.B. Requirements:

1. Power requirements for the SBT unit shall be as required by the manufacturer. Power will be provided by the base building electrical and is to be coordinated by the BHSC with the OAR, Base Building General Contractor, Base Building Electrical Contractor, and Base Building Electrical Engineer.

2.9.C. Interface:

1. SBT unit shall interface with BHS via Ethernet or other equal communications protocol approved by the Owner or OAR.
2. SBT unit shall interface with the Airport systems and non-airport services via Ethernet in a secure manner using appropriate firewalls, encryptions, and other acceptable methods in compliance with codes and standards required by the Contract Documents. BHSC is to coordinate with the OAR, Base Building General Contractor, Base Building Information and Communications Technology (ICT) Contractors for CUSS and CUPPS requirements.

2.9.D. Testing:

1. All controls, features, and interfaces of each SBT unit shall be tested and commissioned by the BHSC with OAR witnessing and each item to be tested shall be identified in the BHS Test Plans in accordance with the Test Plan requirements in Part 4 herein.

2.10 SELF-BAG DROP (SBD):

2.10.A. General:

1. Provide Self-Bag Drop (SBD) units in quantity and locations as shown on the BHS Contract Drawings and as specified herein. Unit shall be acceptable to the Owner and OAR prior to procurement and installation.

2.10.B. Requirements:

1. Self-Bag Drop (SBD) units shall have Intelligent vision system with artificial intelligence to identify the presence of baggage in the unit, the presence of a bag tag, tub detection, capability of reading the bag tag for verification of association with user and boarding pass, and identification of non-baggage items for intrusion detection when passing through a virtual intrusion curtain, which shall immediately stop the operation. Where identified in the BHS Contract Drawings and/or work scope herein, provide a

security door at the downstream end of the SBD that shall close upon non-baggage intrusion to prevent unauthorized access to the conveying system and secured areas for safety and security.

2. SBD shall have 3D dimensioning and baggage weight analysis/capture capabilities to identify if the bag is conveyable or non-conveyable, standard size or oversize.
3. Unit shall provide a passenger friendly interface with fast transaction processing and biometric enabled capabilities of multi-biometric detection including fingerprint and face detection with database integration for seamless travel.
4. SBD unit shall have Emergency Stop Buttons on all sides accessible by the users.
5. Unit shall have, but is not limited to, the following components:
 - a. Display/Touchscreen: 15" (Minimum) Touchscreen, CUSS Compliant with Anti-Glare Screen Finish:
 - b. Barcode Scanner: Boarding Pass 1D/2D Barcode Reader and Automated Bag Tag Scanner.
 - c. Passport Reader: Passport, ID, VISA reader with ePassport/RFID capability.
 - d. RFID Bag Tag Reader.
 - e. High Performance PC with 8GB RAM (Upgradable to 32GB).
 - f. For one-stop CUPPS/SBD Operation where require by the Contract Documents, provide:
 - 1) Insert Card Reader/Chip-and-PIN Payment (EMV) for Payment Options. May also include NFC/RFID Touch Payment option.
 - 2) Boarding Pass Printer, Bag Tag Printer with RFID writer, and Receipt Printer.
 - g. Power requirements for the SBD unit shall be as required by the manufacturer. Power will be provided by the base building electrical and is to be coordinated by the BHSC with the OAR, Base Building General Contractor, Base Building Electrical Contractor, and Base Building Electrical Engineer.

2.10.C. Interface:

1. SBD unit shall interface with BHS via Ethernet/IP (ODVA Technologies and Standards), ProfiNet/ProfiBus, or other equal communications protocol approved by the Owner or OAR.
2. SBD unit shall interface with the Airport systems and non-airport services via Ethernet in a secure manner using appropriate firewalls, encryptions, and other acceptable methods in compliance with codes and standards required by the Contract Documents. BHSC is to coordinate with the OAR, Base Building General Contractor, Base Building Information and Communications Technology (ICT) Contractors for CUSS and CUPPS requirements.
3. Emergency Stop system internal to the SBD is to interface with the BHS E-Stop system in compliance with codes and standards required by the Contract Documents. SBD E-Stop activation shall interface with the BHS E-Stop system to stop the SBD and BHS E-Stop zone and BHS E-Stop activation in the

E-Stop zone associated with the SBD shall interface with the SBD E-Stop system to stop the SBD and BHS E-Stop zone.

2.10.D. Testing:

1. All controls, features, and interfaces of each SBD shall be tested and commissioned by the BHSC with OAR witnessing and each item to be tested shall be identified in the BHS Test Plans in accordance with the Test Plan requirements in Part 4 herein.

2.11 VIDEO CODING SYSTEM (VCS) ENCODING:

2.11.A. General:

1. Provide VCS Encoding workstations in quantity and locations as shown on the BHS Contract Drawings and as specified herein. Unit shall be acceptable to the Owner and OAR prior to procurement and installation. For new or complete replacement ATR installations, VCS Encoding shall be part of the ATR system, as described below. For retrofit or upgrade conditions, VCS Encoding shall be provided by adding cameras, hardware, and software to the existing ATR, as described below.

2.11.B. Requirements:

1. New ATR Array, as per 2.8.Q - Automated Bag Tag Reader Array (ATR):
 - a. VCS: Utilizing the ATR cameras, the system shall be capable of Video Coding the information from the bag tag for identification when the bar code is not machine readable in a minimal amount of time. This is to be used to reduce the number of bags being sent to the Manual Encoding Station (MES), allowing the MES to be an on-call service to reduce staffing requirements. Access from Baggage Control Room (BCR) to Manual Encoding Stations must be unobstructed.
2. Retrofit/Upgrade VCS Encoding:
 - a. Cameras:
 - 1) 2/4-megapixel resolution; high frame repetition rate of 40 Hz
 - 2) Dynamic focus adjustment from object to object
 - 3) Integrated high-power LED illumination
 - 4) Function buttons, aiming laser, optical and acoustic feedback signal
 - 5) Intelligent, rapid decoding algorithms
 - b. VCS: Utilizing the cameras, the system shall be capable of Video Coding the information from the bag tag for identification when the bar code is not machine readable in a minimal amount of time. This is to be used to reduce the number of bags being sent to the Manual Encoding Station (MES), allowing the MES to be an on-call service to reduce staffing requirements.
3. Power requirements for the VCS unit(s) shall be as required by the manufacturer. Power will be provided by the base building electrical and is to be coordinated by the BHSC with the OAR, Base Building General Contractor, Base Building Electrical Contractor, and Base Building Electrical Engineer.

2.11.C. Interface:

1. VCS workstations shall interface with BHS via Ethernet or other equal communications protocol approved by the Owner or OAR in a secure manner using acceptable methods in compliance with codes and standards required by the Contract Documents. BHSC is to coordinate with the OAR, Base Building General Contractor, Base Building Information and Communications Technology (ICT) Contractors for requirements.

2.11.D. Testing:

1. All controls, features, and interfaces of each Encoder shall be tested and commissioned by the BHSC with OAR witnessing and each item to be tested shall be identified in the BHS Test Plans in accordance with the Test Plan requirements in Part 4 herein.

2.12 INTRUSION DETECTION DOORS (IDD): NA

2.13 MOBILE INSPECTION TABLE (MIT): NA

2.14 RADIATION DETECTION ARRAY (RDA): NA

2.15 BAGGAGE IMAGE and WEIGHT IDENTIFICATION SYSTEM (BIWIS):

PART-3 EXECUTION

3.1 GENERAL:

- 3.1.A. Prior to the work of this section, carefully inspect the work of all other trades and sections and verify that all such work is complete to the point where the work may properly commence.

3.2 EXAMINATION:

- 3.2.A. BHSC's Quality Control Requirements:

1. Comply with applicable provisions of Division 01 Section 01 40 00 "Quality Requirements" for requirements for BHSC Quality Control Program
2. General Requirements:
 - a. Workmanship: The Work shall be of acceptable quality and be performed by personnel skilled in their trade in accordance with the approved quality control/assurance plans. BHSC will correct any defective work at their own expense.
 - b. BHSC is responsible to examine conditions under which baggage system work will be installed and notify the Owner in writing of any unsatisfactory conditions.
 - c. Inspection: Work under this contract shall be subject to inspection by the Owner's representative to ensure conformity with the drawings, specifications and contract terms. Cooperate with the Owner's representative and provide assistance at all times for the inspection of the electrical work performed under this contract. Remove covers, operate equipment, conduct insulation tests, or perform all reasonable work, which in the opinion of the Owner's representative, would be necessary to determine the quality and adequacy of the work performed.
 - d. Site Interfaces: BHSC shall be responsible for the following:
 - 1) Protecting Baggage Handling System equipment.
 - 2) Covering and protecting Baggage Handling System equipment from debris and dirt.
 - 3) Removing daily erection debris and discarded materials.
 - 4) Equipment staging area (will be assigned by GC).
 - 5) Coordinating the work schedule with GC.
 - 6) Means for loading, transport, unloading and staging of all BHS related materials onsite.

3.3 MECHANICAL INSTALLATION:

- 3.3.A. General:

1. Install the conveyor equipment true and properly aligned, complete in all details, in accordance with the specifications and manufacturers' recommendations, and as indicated on the drawings.

2. Finish all slider bed and sideguard joints smooth and free from snags and protrusions, which, could damage baggage or otherwise cause the system to jam.
3. All rollers and bearings shall be easily accessible for removal. Assemble all equipment in a manner to facilitate routine maintenance.
4. All stairways, catwalks, crossovers, handrails, fences, working platforms, etc., shall be painted OSHA safety yellow.

3.3.B. Installation Tolerances:

1. Gaps between end rolls shall be as required by code.
2. Uneven joints in conveyor sideguards, static guides, and static deflectors shall be epoxy filled and ground smooth to eliminate all snag points.
3. Where sideguards break for ATR or other conditions, downstream sideguard design must incorporate flare to avoid jams and snags.

3.3.C. Welded Construction:

1. Provide welded connections for fabrication and installation of work wherever bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.

3.3.D. Ceiling Attachments:

1. Ceiling attachments shall be designed to avoid the transmission of excessive conveyor periodic or transitory loads into the structure. (The Owner shall determine the acceptability of specific conditions.)
2. Attachments to steel beams shall be clamped. Attachments to concrete slabs shall be with drilled expansion anchors sized for the load with adequate safety factors and not exceeding 3" in depth. Attachments to concrete beams shall be with drilled expansion anchors into the sides of beams only and placed a minimum of 6" up from the bottom of beam. All attachments shall be submitted for approval.
3. Replace fireproofing materials to an equal depth as the existing fireproofing at attachment locations. Fireproofing shall be of the same type and brand as the existing.

3.3.E. Belting:

1. Mechanically spliced:
 - a. All belt lacing must be Clipper type, No. 2 or No. 1 sized based upon belt manufacturer's specifications.
 - b. Belt lacing must be installed to prevent damage.
 - c. Belting material and the related lacing must be trimmed to provide a 45-degree 3/4" deep V-notch at the corners.
 - d. All belts must be installed as continuous belting with laced joints. No "dutchmans" are allowed.

2. Vulcanized:

- a. BHSC to adhere to all specifications and requirements from the vulcanizing equipment manufacturer to properly perform this process.
- b. Unless stated otherwise, BHSC is to provide to the owner all the vulcanizing equipment needed for maintenance and repairs.

3.3.F. BHS Component Identification:

1. All conveyor sections and other BHS components must be labeled with 6" tall stencils identifying their equipment numbers, generally in the vicinity of the drive section. Conveyor IDs must match as-built documents and controls system identification and be clearly visible from normal maintenance access side of conveyor and not obstructed by motors, control panels, other equipment or obstructions. Label conveyor ID on both sides of conveyor where useful for maintenance identification. Color and format of conveyor IDs must be approved by the OAR.

3.4 ELECTRICAL/CONTROLS INSTALLATION:

3.4.A. General:

1. Controls/Electrical Drawings:

- a. Drawings shall be submitted for review and approval. Controls/electrical work as identified herein shall not be started without approved shop drawings.
 - 1) Wire numbers shall identify all wiring shown on controls/electrical drawings.
 - 2) All equipment shall be properly labeled on controls/electrical drawings.
 - 3) All equipment and wiring contacts shall be properly cross-referenced for easy review and installation.
 - 4) Fuses to be identified by wiring diagram rung ID.

3.4.B. Wire and Cable Identification:

1. Field electric wire and cable shall be color coded and shall have the wire numbers as shown on the electrical drawings affixed to both ends of each wire, and every 5'-0" apart throughout the length of each wire and cable. Coding shall be as follows:
 - a. Power Wiring - Line Side: This code applies to all field power wiring from source to the line side of the fuse in the Motor Control Panel. The neutral, if applicable, shall terminate at the terminal board.
 - 1) Phase "A" - (120/208) Black - (277/480) Brown
 - 2) Phase "B" - (120/208) Red - (277/480) Orange
 - 3) Phase "C" - (120/208) Blue - (277/480) Yellow
 - 4) Neutral - (120/208) White - (277/480) Gray

5) Mech. Ground - (120/208) Green - (277/480) Green

b. Power and Control Wiring - Load Side: The code for field power and control wiring from the load side of the fuses in the Motor Control Panel to all other devices shall be as follows:

1) Power – Black

2) A.C. Control – Red

3) D.C. Control – Blue

4) Neutral – White

5) Mech. Ground – Green

2. Communications system wiring: Installation and termination of wiring shall follow premise wiring and horizontal cabling specifications. Cabling shall be properly labeled, supported, and terminated per industry standards. Cable routing shall be neat and dressed out in appearance with adequate service loops and proper Velcro tie straps where applicable.

3.4.C. Electrical Equipment Labeling:

1. Labeling shall comply with Specification Division 26 for Electrical Identification requirements and per the Baggage System Contract Documents.
2. It is the intent to have the complete electrical system clearly and properly labeled to indicate the loads served and the function of each item of equipment provided under this Work.
3. Control panels, control stations, disconnect switches and junction or pull boxes for other than branch circuit wiring shall be provided with a securely attached engraved label. Provide labels for Owner-furnished control equipment installed on this project. Photocells shall have their assigned number neatly stenciled, in white paint, with two-inch high letters, on the conveyor frame next to the photocell.
4. Label all wiring with the appropriate wire number on both ends of the wire, i.e., at terminal boards, relay terminals, splices, etc. Wire numbering shall reflect the wire numbers used on the wiring diagrams of the electrical/control drawings.
5. Label all components within control panels, identifying the unit by the numbers given on the schematics.
6. Identify control station functions with legend plates attached to the controller unit and nameplates for each device as shown in quotes on the schematics.
7. All motor numbers shall be at least four inches high, neatly stenciled on the conveyor sideguard next to the motor. Paint color shall be white.
8. The main switchboard breakers, fire alarm equipment cabinets, distribution panel schedules, disconnect switches and junction or pull boxes for other than branch circuit wiring shall be labeled with a phenolic-engraved nameplate securely attached with rivets or contact cement.
9. Label all computer and network equipment to match the nameplates given in the as-built drawings.

10. Systems that are renamed shall have identities updated at all locations (Panels, J-Boxes, Circuit Breakers, Contactors, Overloads, etc.). Dual names for old and new components would be acceptable for interim systems

3.4.D. Exterior Conditions:

1. Provide weatherproof protection for exterior conditions in accordance with code requirements and manufacturer's requirements, where applicable. Provide weatherproof protection for exterior mounted equipment, to allow for proper operation of such equipment without personnel intervention.

3.4.E. Raceway Systems:

1. Installation:
 - a. Refer to Specification Division 26 for requirements. Do not install conduit under floor-mounted conveyor unless approved by the Owner's representative. Do not install conduit along the outside sideguard of conveyor curves. Do not attach conduit to floor.
 - b. All conduits and brackets less than 36" above the top of conveyor bed shall be protected with tapered sideguard, 4" standoff, or approved equal.

3.4.F. Wiring:

1. Branch Circuits and Control: Refer to Specification Division 26 for additional requirements. Provide all branch circuit and control wiring as required herein and on the drawings, in accordance with NEC requirements, and for a complete and operational system. Motor feeders shall be in separate wireways and not combined with control wiring. Communication wiring/cabling shall be in separate wireways and not combined with control wiring or motor feeders. Exact routing and associated raceways shall be determined by the BHSC, subject to approval by the Owner's representative. Existing in-place raceways and wireways shall be used wherever available and practical. All raceways shall contain a minimum of six spare wires or ten percent of the total count, whichever is greater. Do not intermix wiring from separate raceway systems in common junction boxes. Do not combine wiring shown in separate raceway systems unless permitted by the Owner's representative. Wiring for system(s) from a MCP shall not be co-mingled with other MCP systems in wireways or boxes. Co-mingling of wiring between subsystems within a system is acceptable. Control wiring, power wiring, and communications wiring shall not be co-mingled.
2. Feeders: Refer to Specification Division 26 for requirements.
3. Connections to Panelboards and Switchboards: Refer to Specification Division 26 for requirements.

3.4.G. Motor and Equipment Connections:

1. General: Provide all motor and equipment connections as required herein, on the baggage system drawings, and as required by NEC for a complete operational system.
2. Disconnect Switches: Provide disconnects at all motors and equipment items unless the equipment has a self-contained, code-approved disconnecting method. Mount disconnect switches on sideguard adjacent to motor and clutch/brake, where possible, and as close as practical to the device being controlled. Provide auxiliary supports as required. Label disconnect switches with the system and motor number. Disconnect switches shall be provided for all clutch/brakes. Either the motor disconnect switch

shall be of a type and size to disconnect the motor and the clutch/brake or two disconnects shall be provided. Disconnect switches shall be UL listed.

3.4.H. Photoelectric Cells:

1. Fasten all photoelectric cells and mounting hardware with hex head bolts and Esna stop nuts. Mount photoelectric cells associated with conveyor belt systems no more than one and a half (1.5) inches above the belt surface. Provide necessary openings on sideguards of belt conveyors. All openings in sideguards shall be ground smooth, to prevent bag damage. Mount photocell reflectors in such a way as to protect them from damage from bags, etc.

3.4.I. Control Stations:

1. Provide all necessary auxiliary mounting hardware to install remote-mounted control stations as indicated in the document. Location of control stations in public view shall be field verify with the OAR prior to rough-in.
2. Control station locations indicated in design documents are approximate. Prior to rough-in verify approval of all proposed locations on site with the OAR. Conditions at site walk for approval must acknowledge installation of all elements impacting location of controls, such as motors, gearboxes, control panels and/or boxes along conveyors, maintenance access crossovers, etc. BHSC must relocate control stations if the OAR finds changed conditions that impact placement of previously approved control stations.

3.4.J. Emergency Stops:

1. E-Stop Device shall be provided at each operator control station, unless determined not necessary by risk assessment as per NFPA 70E/EN ISO 13850.
2. E-Stop Device shall be provided at locations required by risk assessment (e.g. conveyor access points, loading/unloading areas (man/machine interface points), etc.) as per NFPA 70E/EN ISO 13850.
3. Emergency stops shall be located with unobstructed access and capable of safe activation by anyone needing to activate the device as per NFPA 70E/EN ISO 13850.
4. Emergency stop should be mounted between 24" (600mm) to 66" (1700mm) above the access level (e.g. finish floor, top of slab, platform, etc.) as per NFPA 70E/EN ISO 13850. If this is not possible due to site conditions, it shall be identified in RFI to OAR for review and possible acceptance.
5. Emergency stops shall be located along conveyors such that an E-Stop is no farther away than 25 feet for anyone along or in the BHS to shut down the BHS operation.

3.4.K. Motor Control Panels:

1. Panels: Install panels as indicated on the drawings. Location is approximate; verify with the Owner's representative prior to rough-in. Bolts shall be hex head with Esna stop nuts.
2. Neatly arrange components in the panel with like-type items adjacent to each other wherever practical. In general, mount overload units for motors at the bottom of the motor starter portion of the panel, with contactors and breakers in consecutive rows above. Mount the main breaker near the top of the panel to facilitate interlocking with the door.

3. Provide wiring troughs between banks of relays and contactors with a minimum clearance of two inches from troughs to control components.
4. Provide terminal blocks for all control conductors leaving the control panel. Cover-mounted push buttons, selector switches and pilot lights will be considered remote equipment for termination purposes.
5. Number all wiring within the control panel with a unique ID.
6. Provide legend plates and nameplates for all cover-mounted devices.
7. Label all devices within each panel with the designation of the device as indicated on the schematic.
8. Motor Control Panels located on concrete slabs shall be installed on housekeeping pads. Housekeeping pads for interim Motor Control Panels shall be removed when the interim panel is removed, and the concrete slab shall be refinished to match the surrounding slab.

3.5 SOFTWARE INSTALLATION:

3.5.A. Programming:

1. Each system shall be programmed by the conveyor supplier or approved representative to function as specified herein. A printout of the programming shall be provided to the airport authority for their use. Refer to submittal requirements identified herein.
2. BHSC shall accomplish and provide all programming of the programmable logic controllers, message centers, and displays. Hardcopy of programming shall be submitted for review and approval. Installation of programming as identified herein shall not be started without approved submittals.
3. Programming shall include synonyms, labels, and comments for all inputs, outputs, and relays.
4. PLC logic shall provide a sequenced start of all motors, to eliminate any power “inrush”.
5. Programming of PLCs and message centers shall cover all operational events.
6. A final draft printed copy (letter size) of the PLC, message center, and display programs shall be provided along with a final draft copy of all of the programming computer files prior to start-up. A final printed copy (letter size) of the PLC, message center, and display programs shall be provided along with a final copy of all of the programming computer files in the O&M Manuals. Refer to submittal requirements herein.
7. BHSC shall provide two copies of the online and offline programming software for the PLCs provided with this system.
8. BHSC to provide a complete set of back-up/rebooting/install CDs for each computer.
9. Software Documentation: Provide latest commercially available nonproprietary software wherever possible and applicable, unless application requires customized programming. Beta software is not acceptable. All software proprietary information shall be provided to the Owner prior to Final Acceptance, but shall not indemnify the Baggage System Contractor for technical defects that occur with the software. Program source codes with Non-Disclosure Agreement and software licenses for this Work shall be owned by the Owner. Applications including, but not limited to, PLC programs, reports, and fault monitoring displays, developed from the software, either non-proprietary or proprietary, shall not

be construed as proprietary and shall be owned by the Owner for their use and distribution as necessary for future additions and modifications. If a Non-Disclosure Agreement is not acceptable, then proprietary program source codes shall be placed in escrow for the Owner's access.

3.6 AS-BUILT DRAWINGS:

- 3.6.A. In addition to the requirements for As-Built Record Drawings in Specification Section 01 78 00, BHSC shall provide As-Built Record Mechanical and Electrical Drawings for the baggage systems, in hardcopy and electronic format, which shall consist of BHSC's final shop drawings with all corrections complete. Hand marked information on these copies is not acceptable. Each MCP shall have a hardcopy of its associated electrical as-built record drawings.

3.7 NEW EQUIPMENT DEMONSTRATION:

- 3.7.A. Pre-Installation Demonstration and Testing of New Equipment Types:

1. Any new concept of new Baggage Handling System equipment that the BHSC recommends for the system(s) must first be thoroughly demonstrated prior to the Owner/Representative's consideration of actual approval or implementation and consistent with substitution request requirements.
2. By mutual agreement between Owner/Representative and the BHSC, the demonstration and/or testing of the new concept of equipment can be achieved through:
 - a. Thorough demonstration at the BHSC's Manufacturing Facilities.
 - b. Field demonstration at one or more sites that the BHSC has already implemented/installed the new concept equipment, if available.
3. Specific demonstration and testing requirements for the new concept or equipment will be developed by the Owner's Representative.
4. The specific demonstration and testing requirements will identify such requirements as: Number of test cycles, number of hours of "run time", material processing rates, physical characteristics of material to be processed, Mean Time Between Failures, Mean Time to Repair, serviceability, etc.

3.8 TESTING AND COMMISSIONING:

- 3.8.A. Refer to Part 4 for All Testing and Commissioning:

3.9 DEFICIENCIES:

- 3.9.A. BHSC shall track all deficiencies found during installation and testing in a tabular form with dates, descriptions, locations, correction by, and correction status. This deficiency list shall be submitted to the OAR on a weekly basis during installation and testing in electronic excel or CSV format.
- 3.9.B. Owner's staff and OAR will also track all deficiencies observed during installation and operation in tabular form with dates, descriptions, locations, correction by, and correction status and will provide the deficiency list following their onsite observation walk-throughs or testing observations.
- 3.9.C. Deficiency tracking software package can be used and is recommended for the project. Software to be accepted by OAR.

3.9.D. BHSC shall correct all deficiencies in the timely manner and prior to final acceptance.

3.10 ACCEPTANCE OF SYSTEM:

3.10.A. Conditional Acceptance (Beneficial Use):

1. The following shall be required for total system(s) conditional acceptance:
 - a. Satisfactorily pass the tests as outlined herein and required by the Owner.
 - b. All submittals have been accepted with either “No Exceptions Taken” or “Make Correction Noted” as the status of the submittal. No “Revise and Resubmit” or “Rejected” submittals remain open.
 - c. Resulting Punch List of installation and testing are relatively minor in nature and do not prevent Beneficial Use of the system(s).

3.10.B. Final Acceptance:

1. Final acceptance of the system(s) shall require the BHSC to have completed all Punch list items to the satisfaction of the Owner and OAR
2. The OAR will attend one initial demonstration/observation and one follow-up demonstration/observation. Any cost for additional observations required to “clean up” Punch list items will be at the BHSC’s expense

3.11 WARRANTY:

3.11.A. Refer to Part 5 for Warranty:

3.12 START-UP SUPPORT:

3.12.A. Activation Support for Cutovers:

1. Baggage System Contractor shall provide 16 hours of on-site mechanical, electrical, and programming support for two (2) consecutive days immediately following a cutover of a subsystem. Time of support shall be coordinated with hours of operation. Programming may be performed on-line, provided that on-site staff can support programming efforts.

3.12.B. Live Bag Operations.

1. Baggage System Contractor shall provide 16 hours of on-site mechanical, electrical, and programming support for 30 consecutive days immediately following live bag operation in Checked Baggage Inspection System (CBIS). Time of support shall be coordinated with hours of operation. Programming may be performed on-line, provided that on-site staff can support programming efforts.

3.12.C. Baggage Portering during phase cutovers:

1. Baggage System Contractor shall provide portering from the existing make-up area to the new outbound baggage system after the new system has been accepted by TSA and the Airport until the new ticketing lobby is complete, operational, and occupied by the Airline tenants.

2. Baggage System Contractor shall provide bag portering from any shutdown ticket counter conveyor to a live ticket counter conveyor due to baggage system construction activity or any shutdown as needed. Refer to the Special Provisions for additional portering requirements

3.13 SCHEDULED TRAINING:

3.13.A. General:

1. BHSC must submit a training syllabus for concurrence by the Owner at least 30 days prior to start of training. Training will not start until the syllabus and training schedule are mutually agreed upon between the Owner and BHSC.
2. All training sessions must be digitally recorded by the BHSC with the Owner receiving two digital copies of the training sessions in either MP4 or AVI format.
3. The training sessions must be organized, using presentation materials, handouts, Power Point presentations and other training tools to thoroughly demonstrate and explain the operational, maintenance and safety characteristics of the system.
4. Training must include classroom and “hands-on” instruction.
5. Prior to the start of use, BHSC must provide the following training to Owner, TSA and tenant airline personnel:

3.13.B. Airport Operations Training:

1. BHSC to provide suitable hours (separated into sessions to allow for multiple shift work personnel) of training for the Carriers, Airport, and 3rd party operators, to cover the operational functions of all systems and all pertinent sections of the Operations Manual.
 - a. Operator training must include, but not be limited to:
 - 1) BHS orientation and layout
 - 2) System safety
 - 3) Startup procedures
 - 4) Upper level menu and navigation
 - 5) HMI alarms and system reporting
 - 6) Manual encoding
 - 7) Controls functionality, modes of operation, operational limitations
 - 8) Any BHSC provided equipment
 - 9) BHS control interface provided to conduct the OTK procedures
 - 10) BHS orientation and layout

11) BHS fail-safe procedures and layout

1. All operators or individuals with access to either viewing or printing reports must be properly trained in SSI procedures prior to operation. The training sessions must be conducted prior to the operational startup of the respective BHS.

3.13.C. Airport Maintenance Training:

1. Training shall include “classroom” and “hands-on” programs covering actual troubleshooting, adjustment of equipment, and component removal and replacement.
2. The training classes shall be provided prior to the operations startup of the system.
3. The supplier or approved representative shall provide training for programmable controller operations and programming procedures.
4. Training shall be provided for, but is not limited to, the following items.
 - a. Mechanical Training – Training in the operations and maintenance (including removal, replacement, and set up) of the equipment shall be provided for, but is not limited to, the following items:
 - 1) Reducers.
 - 2) Clutch/Brakes.
 - 3) Brake Motors.
 - 4) Bearing.
 - 5) Belting and Lacing.
 - 6) Power Turns.
 - 7) Coiling Security/Fire Doors.
 - 8) Draft Curtains.
 - b. Electrical Training – Training in the operations and maintenance (including removal, replacement, and set up) of the equipment shall be provided for, but is not limited to, the following items:
 - 1) Variable Frequency Drives (VFD) and connection to the PLC Network.
 - 2) Photoeyes.
 - 3) Tachometers.
 - 4) Motor Starters.
 - 5) Motor Safety Disconnects.
 - 6) Components in the Motor Control Panels.
 - c. For the Electronic Technicians (ETs), the tasks that they shall be able to accomplish are as follows:

- 1) Computers, Network:
 - a) Configure and replace any one of the server or workstation machines (to recover from hard-drive failure, for instance).
 - b) Identify all networked devices connected as part of this system; verify network connectivity to each.
 - c) Monitor communication; identify and diagnose incorrect communication between the various servers and workstations (online/offline dialog; database client connections; web client connections).
 - d) Verify the self-health-check of any machine; identify and correct the deficiency (start/bounce services or applications - short of reboot).
 - e) Check operational and debug logs; set debug levels.
 - f) Backup each database instance; restore each database instance from backup.
 - 2) Field Devices:
 - a) Configure and replace any one of the field devices.
 - b) Monitor communication; identify and diagnose incorrect communication to/from any field device or external device.
- d. To accomplish item 1 above, the ETs shall have training to include details about:
- 1) Services:
 - a) On each machine, a list of services that take an active part in the proper operation, symptoms if failed, the services' proper configuration, any interactions or dependencies, any unusual steps to restart any service.
 - 2) Network:
 - a) List of all network devices.
 - b) List of ports and protocols used and which devices and software transactions use.
 - c) Switch configuration.
 - d) Firewall configuration.
 - 3) Database:
 - a) Which machines run database instances; which machines attach to each database.
 - b) How is the database configuration different from standard ('out of the box')?
 - c) What backup/restore plan.
 - d) Non-standard reports.

- 4) Hot Standby/Failover:
 - a) Each machine's method of self-health-check.
 - b) Health dialog between machines.
- 5) Application Installation:
 - a) How to prepare a machine for the installation of each of the applications.
 - b) Software installation of each of the applications.
- 6) Diagnostic tools, procedures, and logs:
 - a) Where do the applications and services keep logs?
 - b) What control of detail for info put into log (debug level?).
 - c) What other diagnostic tools or procedures will isolate problems and help to gather information for subsequent resolution.
- 7) PLC communication:
 - a) Which machines communicate with the PLCs.
 - b) What protocols.
 - c) What redundancy.
 - d) How to verify communication.
- 8) Other field device communication:
 - a) What field devices are driven.
 - b) What protocols.
 - c) What redundancy.
 - d) How to verify communication.

3.13.D. TSA Operations Training:

- 1. BHSC to provide suitable hours (separated into sessions to allow for multiple shift work personnel) of training shall be provided to TSA by the BHSC for mechanical, electrical, and computer functions required to properly operate the TSA staffed portions of the system. Training sessions shall be videotaped, and the tapes turned over to the Owner. Training shall include, but is not limited to the following:
 - a. CBIS orientation and layout review.
 - b. Any BHS provided equipment installed in the CBRA.

- c. Any BHS provided equipment installed in the OSR Room
 - d. Any BHS provided equipment installed in the On-Screen Resolution (OSR) room.
 - e. BHS controls operation for the Image Quality Test (IQT) procedures.
 - f. CBIS failsafe procedures and layout review.
 - g. System safety.
 - h. Bag jam clearing procedures.
 - i. BHS/TSA reporting
 - j. BHS control interface provided to conduct the OTK procedures
2. Training on any BHS reports classified as SSI. Training sessions shall comply with government Sensitive Security Information (SSI) guidelines as identified in TSA's latest version of their Planning Guidelines and Design Standards.
 3. BHSC shall submit a syllabus of the training sessions for review and coordination prior to the actual training sessions.
 4. TSA will identify personnel that they want to attend the training session(s) prior to training and the BHSC shall provide sufficient training materials.

3.13.E. Airline Operations Training:

1. BHSC to provide suitable hours (separated into sessions to allow for multiple shift work personnel) of training for the Carriers, Airport, and 3rd party operators, to cover the operational functions of all systems and all pertinent sections of the Operations Manual.
 - a. Operator training must include, but not be limited to:
 - 1) BHS orientation and layout
 - 2) System safety
 - 3) Startup procedures
 - 4) Upper level menu and navigation
 - 5) HMI alarms and system reporting
 - 6) Manual encoding
 - 7) Controls functionality, modes of operation, operational limitations
 - 8) Any BHSC provided equipment
 - 9) BHS control interface provided to conduct the OTK procedures
 - 10) BHS orientation and layout

11) BHS fail-safe procedures and layout

2. All operators or individuals with access to either viewing or printing reports must be properly trained in SSI procedures prior to operation. The training sessions must be conducted prior to the operational startup of the respective BHS.

3.13.F. Supplemental Training:

1. If Owner requires supplemental training prior to or during training beyond that specified above, it must be provided by BHSC at a time and at rates as mutually agreed upon between Owner and BHSC.

3.14 CLEANING:

3.14.A. Pre-Installation:

1. Stored BHS equipment must be kept clean from dirt, rust, and debris. The BHSC is responsible to provide any necessary means to protect/maintain equipment to prevent build-up of dirt and debris from storage area.

3.14.B. During Installation:

1. Installed BHS equipment must be kept clean from dirt and debris. Conveyor, slope-plate and flat-plate recirculating devices, and other BHS components can be damaged if operated with construction dust, dirt, and/or debris on moving parts, so the BHSC is responsible to provide any necessary means to protect/maintain equipment to prevent build-up of dirt, rust, and debris from general construction.
2. During installation, the BHSC and/or its subcontractor shall clean the debris in each motor safety disconnect, junction box, control station and MCP before closing each enclosure and/or panel

3.14.C. Post Installation:

1. Prior to startup of the belt conveyors, polish and buff the bed surface smooth and free of sharp edges, dirt, paint and grease. Apply a coating of talc powder between the surfaces of the bed and the belt.
2. BHSC shall completely clean baggage system equipment prior to turning it over to the Owner and shall protect the equipment from dirt and debris after it has been cleaned until it is turned over to the Owner for use.

3.15 SPARE PARTS:

3.15.A. Spare Parts List:

1. The Baggage System Contractor shall submit to the Owner's Representative, at the time that the system(s) design engineering has been completed (both electrical as well as mechanical), a list of all parts used in the development of the system(s). This complete listing of system(s) parts will then be used by the Owner/Representative to develop a listing of parts to be purchased as Spare Parts for the support of the system(s). This list must include the following:
 - a. Name of part.
 - b. Complete description of part.

- c. Each specific location that the listed part is used in the system(s).
 - d. Total number of parts in the system(s).
 - e. Manufacturer of the part.
 - f. Manufacturer's part number.
 - g. Source of supply.
 - h. Baggage System Contractor recommended quantity of spares per each item.
 - i. Price per unit.
 - j. Lead time or availability of part.
- 2. The listing of the above information regarding parts must be provided for each system.
 - 3. Identify recommended and critical spare parts on the parts list along with their prices and suppliers.
 - 4. Spare parts shall be deliverable within 24 hours notice, except for long lead items, which shall be identified on the list.

3.15.B. Required Spare Parts:

- 1. BHSC shall provide the following Spare Parts to Owner's Maintenance Department 30 days prior to system turn over for their use.
 - a. Gear Reducers: Provide one gear reducer of each type installed.
 - b. Pulleys: Provide one pulley of each type installed.
 - c. Bearings: Provide one bearing of each type installed.
 - d. Belting: Provide one 45 Degree Power Turn belt, one 90 Degree Power Turn belt, and one 90 Degree Spiral Turn belt of each size of Spiral Turn installed.
 - e. Motor Circuit Protector: Provide one Motor Circuit Protector of each type installed.
 - f. Motor Starter: Provide one Motor Starter of each type installed.
 - g. Relays: Provide one Relay of each type installed.
 - h. PLC: Provide one PLC component of each type installed.
 - i. 24VDC Power Supply: Provide one 24VDC Power Supply of each type installed.
 - j. Dual Line Message Centers: Provide one Dual Line Message Center of each type installed.
 - k. Power Filters: Provide one Power Filter of each type installed.
 - l. Soft Starts: Provide one Soft Start of each type installed.

- m. VFDs: Provide one VFD of each type installed.
- n. Photoelectric Cell Sensors: Provide one Photoelectric Cell Sensor of each type installed.
- o. Tachometers Shaft Encoders: Provide one Tachometers Shaft Encoder of each type installed.
- p. Pushbuttons: Provide five Selector Switches Pushbuttons of each type installed.
- q. Selector Switches: Provide five Selector Switches of each type installed.
- r. Pilot Lights: Provide five Pilot Lights of each type installed.
- s. Limit Switches: Provide five Limit Switches of each type installed.
- t. Disconnect Switches: Provide one Disconnect Switch of each type installed.
- u. Warning Lights, Horns, and Buzzers: Provide one Warning Light, Horn, and Buzzer of each type installed.
- v. Network Switches: Provide one Network Switch of each type installed.
- w. Firewall Switches: Provide one Firewall Switch of each type installed.
- x. Baggage Removal Point – Baggage Status Display: Provide one Baggage Status Display of each type installed.
- y. Baggage Inspection Table – Baggage Status Display: Provide one Baggage Status Display of each type installed.

3.15.C. Additional Spare Parts:

1. Additional Spare Parts may be purchased after installation of the systems based on the recommended and critical spare parts list submitted.

PART-4 TESTING AND COMMISSIONING:

4.1 GENERAL TESTING:

4.1.A. BHSC and its subcontractors shall perform any needed testing and inspection of equipment, materials, functions or processes to ensure quality control standards are met to the project expectations.

4.1.B. If Owner requires any general or specific testing beyond that specified herein, it must be provided by BHSC at a time and at rates as mutually agreed upon between Owner and BHSC. (As designer, AECOM should ask Owner what extra testing Owner wants to do and include those requirements in these specifications so BHSC can include in its bid. Otherwise, we are talking about change orders here and the specification should not be focused on change order work, but base bid work. Bottom line, I recommend delete item 2 and focus solely on base bid requirements. There are a number of items that could end up as 'adds' and there should be a specific clause general/special provisions clause in the contract that directs the BHSC on how to 'claim' or request an equitable adjustment.)

4.1.C. Electrical Tests:

1. Testing shall comply with Specification Division 26 requirements.
2. Test all wiring and connections for continuity and grounds before any equipment is connected. Where such tests indicate faulty insulation or other defects, locate, repair and test all such defects and faults and test again. Check the direction of rotation and the lubrication of all motors after final service connections have been made.
3. Check proper operation of all control relays, the programmable controller, timing relays, photocells and motor starters in cooperation with the Owner's representative.
4. Refer to testing and commissioning sections herein for additional requirements.

4.1.D. Testing Sequence:

1. EDS Site Acceptance Test;
 - a. Performed by TSA and EDS OEM.
2. Factory Acceptance Testing (FAT);
 - a. Performed by BHSC and observed by Owner, Appropriate ILDT Staff, and OAR.
3. BHSC Internal Site Testing/Pre-ISAT Testing using ILDT Test Plan;
 - a. Performed by BHSC and observed by OAR.
4. Commissioning/Pre-ISAT using ILDT Test Plan;
 - a. Performed by BHSC and observed by Owner, Appropriate ILDT Staff, and OAR.
5. TRR Readiness Confirmation Letter:
 - a. Prepared by ILDT and submitted by Project Sponsor;

6. Testing Readiness Review (TRR) Tests using ILDT Test Plan;
 - a. Performed by BHSC and observed by TSA Site Lead and OAR.
 7. Testing Readiness Notification (TRN);
 - a. Prepared and issued by TSA Site Lead to TSA Acceptance Testing Team.
 8. Integrated Site Acceptance Testing (ISAT) by TSA.
 - a. Performed by TSA and TSA Testing Contractor with support from BHSC and EDS OEM.
 9. Operational Run-In and Closeout.
 - a. Performed by Operations and BHSC for TSA.
- 4.1.E. Test Plans:
1. The following test plans must be provided:
 - a. BHSC to prepare Factory Acceptance Test Plan as specified in section 4.2.
 - b. BHSC to prepare BHSC Internal Site Test Plan as specified in section 4.3
 - c. BHSC to prepare Commissioning Test Plan as specified in section 4.4
 - d. BHSC and ILDT to prepare ILDT Test Plan as specified in section 4.5 and required in TSA PGDS for review and acceptance by TSA.

4.2 FACTORY ACCEPTANCE TESTING (FAT):

1. The BHSC must demonstrate through emulation/simulation/analysis at the FAT that the system, as engineered by the BHSC, meets the minimum design and performance criteria identified in this specification.
2. BHSC to submit results of all pre-FAT testing to the Owner/OAR 30 calendar days prior to the FAT for review and approval by the Owner/OAR.
3. BHSC shall plan the FAT at least 3 months in advance so attendees can set up their schedules and make arrangements.
4. The BHSC must invite the Owner, OAR, TSA, and Owner's required staff to their facility for a demonstration and review of the BHSC's developed controls systems software, sortation and maintenance diagnostics computer software/hardware and operator interfaces, including but not limited to ISD interfaces and facility interfaces with other airport systems and devices (e.g., Fire Alarm and Airport Security Systems). The BHSC must conduct sortation demonstrations validating the system can effectively sort baggage as required by the specifications.
5. Agenda: BHSC must submit a detailed FAT agenda at least 60 calendar days in advance of FAT for review and approval by Owner/OAR. The FAT Agenda must provide enough detail to adequately describe what the BHSC will be demonstrating during the FAT.

6. Items that are to be validated at a minimum:
 - a. Security testing in accordance with the screening requirements.
 - b. Controls logic
 - c. System graphics
 - d. System reports
 - e. Bag tracking
 - f. System faults
 - g. Sortation
 - h. BSM functionality
 - i. Upper level architecture
 - j. Lower level architecture
 - k. Redundancy (hot-backup) for the upper level servers
 - l. Redundancy (hot-backup) for PLCs
7. The FAT must take place prior to the on-site installation of the BHS computer software and associated hardware.
8. If the BHSC postpones or cancels the FAT 14 calendar days prior to the FAT for any reason, then the BHSC shall be required to compensate the Owner and its representatives for any and all additional costs for changing the schedule.
9. All items identified during the FAT as being deficient must be rectified prior to installation on-site. In order to assure this, the BHSC shall submit to the Owner/OAR their corrective action plan for all deficiencies identified during the FAT. BHSC must provide status reports to the Owner on a weekly basis and may not deploy the system to the field until it assures that Owner that all deficiencies have been adequately corrected. The BHSC is solely responsible for any additional monies incurred regarding completion of this task and will not be granted any schedule variances.

4.3 BHSC INTERNAL SITE TESTING/PRE-ISAT:

1. Testing prior to Commissioning:
 - a. BHSC shall test the operation and functionality of all computer and PLC programming. The operation and functionality of the Supervisory Control System, which includes all Baggage System computers and PLCs, shall be tested at 50%, 75%, and 95% complete using simulations for the baggage system operation prior to final installation and connection to the baggage system.
 - b. After installation of the complete system(s), BHSC shall test the completed system(s). All testing and “debugging” shall be complete prior to the demonstration of the system(s) during commissioning. The testing shall include:

- 1) Complete inspection of all mechanical aspects of the system(s).
- 2) Inspect the system(s) and make adjustments to belt and controls as required.
- 3) Checkout of the operational controls and safety devices of the system(s) using bags, totes, or boxes.
- 4) Test the capability to handle the required sizes and weights of baggage through the system(s) without jamming or toppling of baggage.
- 5) Test the capability to handle the required maximum baggage handling rates of the system(s) in total, using all components/units required to achieve the required rates as specified. The operating speed of each component of the system(s) will be measured using a tachometer in the presence of the Owner's Representatives and be recorded on the Equipment Description list. Any component not operating within 2 percent of design speed shall be reworked to bring it up to design speed.
- 6) BHSC shall provide at least 40 hours of continuous operation under no-load conditions followed by a complete system(s) inspection for necessary corrections, belt adjustments. Such adjustments may include the requirement for retraining of the belts, re-tensioning of the belts and any required shorting of belting material required to meet the maximum take-up adjustment of 2%, as defined under the Section regarding Take-Up Pulleys. The 40 hours of testing shall be conducted a minimum elapsed time of two 20-hour days to a maximum of five 8-hour days.
- 7) BHSC shall perform a load test for each system complying with the load requirements identified herein. Load test shall be performed on the final complete system. BHSC shall provide the load test demonstration immediately following the BHSC's 40-hour no-load test, before the system can cool down, for each system to be witnessed by the Owner's Representative as part of the commissioning effort but can be performed prior to actual commissioning.
- 8) The BHSC shall also perform a 10-hour load test demonstration immediately following the BHSC's 40-hour no-load test, before the system can cool down, for each system to be witnessed by OAR as part of the commissioning effort but can be performed prior to actual commissioning. This will require a minimum of 400 test bags with applied barcoded IATA bag tags. Each test bag with barcode tag shall weigh between 30 Lbs. to 50 Lbs.; and the types and sizes shall be provided according the table below. A successful hour of operational testing shall be defined as the system meeting the performance requirements as defined in the Specification Section 2.1, Paragraph B. During the 10-hour load test, the BHSC shall record the actual current draw by each MCP in every 10-minute interval; the record shall be included in the O&M manual. If any items/concerns/defects are identified by OAR during the test, the BHSC shall remedy the items/concerns/defects during the daytime hours, and the BHSC shall be ready to test the following night.
- 9) The operation and functionality of the Supervisory Control System shall be tested when complete and connected to the baggage system for operation.
- 10) Test of system(s) Fault Monitoring, System Status Panel.
- 11) Test the capability of all sortation and tracking requirements. For sortation, BHSC shall test the system(s) for proper sortation of 200 items. Items can be bags, tubs, wood blocks, etc. or combinations of these items. BHSC shall identify a list of items in the testing plan. For tracking, BHSC shall test all tracking functions and conditions.

- 12) BHSC shall test all interfaces with other systems. BHSC shall coordinate interface testing with all parties involved.
- 13) The following tests, at a minimum, shall be performed:
 - a) Static Inspection:
 - (1) Mechanical.
 - (2) Electrical.
 - (3) Motor Control Panel.
 - b) Dynamic Inspection:
 - (1) Mechanical.
 - (2) Electrical.
 - c) Functional Inspections:
 - (1) E-Stops.
 - (2) Bag Jams.
 - (3) Other Controls.
 - (4) Basic Functions.
 - d) For systems that interface with Explosive Detection System Equipment, the System Interface with Explosive Detection System Equipment Test shall require testing of the system's ability to properly interface with the associated Explosive Detection System equipment. Integrated Site Acceptance Testing (ISAT) from TSA shall be required for systems interfacing with Explosive Detection System equipment. BHSC shall use the latest accepted edition of the Planning Guidelines and Design Standards (PGDS) documentation from TSA at the time of bidding as for the requirements for of the ISAT. . Any subsequent changes in the requirements from this document at the time of testing shall be reviewed with the Owner for potential additional work. Inspections and tests shall be as per the ILDT Test Plan developed by BHSC and ILDT, and approved by TSA.
 - e) Overall System Throughput Test.
 - f) Sortation Test.
 - g) Run-In Period.
 - h) General Site Requirements.

2. BHSC Internal Site Test Plan:

- a. The BHSC shall provide and submit for review and approval a Test Plan for each system(s), which shall, at minimum, incorporate the requirements listed above in the BHSC Internal Site Testing section in this Specification. Refer to Submittal requirements identified herein.
- b. The BHSC is required to develop and submit for review and approval a Test Plan for each system to identify and demonstrate all System Control Functions. The Test Plan is to list each Control Station, Control Devices, etc., and its related control function that is to be demonstrated/tested in a checklist format with “Pass” and “Fail” check boxes, date, and recorder’s initials for each item. Items that fail during a test shall be retested after corrections are made and another checklist shall be used in the test recording of the previously failed items. BHSC shall provide Owner with all checklists produced during testing.
- c. The Test Plan shall also include the recording of the following information per system(s) Conveyor/Device during the inspection and testing of the system(s). All actual speeds and motor currents shall be measured with the system(s) in a “no-load” condition, i.e., all conveyors of a system running, but without product. BHSC shall complete all recording in the Test Plan.

1) Main Feeds:

- a) Fuse size per phase.
- b) Actual amperage per phase.

2) Transformers:

- a) Fuse size per phase.
- b) Actual amperage per phase.

3) Conveyor/Device Speed:

- a) Actual center line speed of conveyor/device.

4) Motor Name Plate Data:

- a) Manufacturer.
- b) Horsepower.
- c) Nameplate Current.
- d) Voltage.
- e) Phase.
- f) RPM.
- g) Frame Size.
- h) Type.

- i) Hertz.
 - j) NEMA Design.
 - k) Service Factor.
 - l) Insulation Class.
 - m) Insulation Type.
- 5) Fuse size per phase.
- 6) Actual amperage per phase.
- 7) Overload heater size or designation.
- d. The material to be used for the Load and Rate Test, plus personnel to handle it, shall be provided by the BHSC. The BHSC shall have all personnel identified by the Owner as Owner's Representatives "on site" during all periods of the system(s) Inspection and Testing. All tests shall be conducted with bags, tubs, blocks, etc. or combinations of these items; and at the Owner's/Representative's option with laded cartons to supplement available baggage.
- e. The BHSC shall provide all necessary testing, measuring, and recording devices required to demonstrate the operational characteristics and performance of the equipment to the satisfaction of the Owner/Representative. At a minimum, the required test equipment shall include: Clamp-on type ammeter, direct read F.P.M. digital readout Tachometer, etc. The BHSC shall provide the latest calibration results for the testing equipment. Calibrations must be current, i.e. less than one year old.
- f. Rate Test will be run with average length (30"-36") bags. It is the intent of the Specifications that the maximum Processing Rate(s) per minute be for average length bags, not for all 54" maximum length bags per minute.
- g. The System Rate Test shall require the demonstration of the system's ability to process the specified items per minute for 15 consecutive minutes.
- h. The System Sort Test - NA
- i. IATA bag tags for testing: The BHSC shall coordinate with the IT staff of the airport to obtain IATA bag tags for testing the BHS. The airport IT staff will coordinate with the airlines.
- 3. Test Failure:
 - a. A failure during any test period shall be defined as any design characteristic or malfunction of the BHSC furnished equipment or materials that damages baggage or reduce any operating rate below those specified. Conditions resulting from improper loading of baggage or loading baggage of sizes not included in the Specification requirements will not be considered as failures.
- 4. Test Bags:
 - a. For Pre-iSAT testing in BHSC Internal Site Testing and Commissioning, and for TRR, the test bag types and sizes shall range in weight and be dispersed between 5 pounds (2.27 kg) to 50 pounds

(22.68 kg). Test bag sets shall contain equal quantities of these bag types and shall be a minimum of 100 bags per EDS unit.

4.3.B. BHSC Internal Site (Pre-ISAT) Testing:

1. BHSC must demonstrate the system in accordance with the TSA approved ILDT Test Plan, developed by the BHSC and ILDT, to the OAR. Coordinate with EDS OEM in support of integration activities (e.g. installation and testing the required software and hardware to allow for digital and serial communication between the EDS and BHS PLC) as needed. Passage of this testing in no way relieves responsibility for corrections of noted discrepancies during this testing or subsequent testing.

4.4 COMMISSIONING/PRE-ISAT:

4.4.A. Materials: BHSC shall provide the following completed documents for commissioning:

1. Final Approved O&M Manuals.
2. Final Mechanical and Electrical As-Built Record Drawings specified herein.
3. Final Electrical As-Built Record Drawings in associated Motor Control Panel.
4. Test Plan Information completed by BHSC.
5. Testing by BHSC is complete.
6. VFD Information & Settings
7. Detailed motor inventory and speeds, HP, etc.
8. PLC and Programming information

4.4.B. Commissioning - Demonstration and Observation:

1. The Owner and/or Owner's Representatives will attend one initial demonstration/observation and one follow-up demonstration/observation. Any cost for additional observations required to "clean up" punchlist items will be at the BHSC's expense.
2. After installation and testing of the complete system(s), its operating capability shall be demonstrated by the BHSC. All "debugging" shall have been accomplished prior to the start of the system(s) commissioning. The demonstration and observation shall include:
 - a. Static Observation: Observe the mechanical and electrical static components and identify deficiencies on the punchlist.
 - b. Dynamic Observation: Observe the mechanical and electrical dynamic components and identify deficiencies on the punchlist.
 - c. Demonstrate the operational controls and safety devices of the system(s).
 - d. Demonstrate E-Stop Zoning operations.
 - e. Demonstrate Bag Jam and Cascade Stop operations.

- f. Demonstrate “Hand-Off-Auto” operations.
- g. Demonstrate the capability to handle the required sizes and weights of baggage through the system(s) without jamming or toppling of baggage.
- h. Demonstrate the capability to handle the required maximum baggage handling rates of the system(s) in total, using all components/units required to achieve the required rates as specified.
- i. Demonstrate the capability of all sortation and tracking requirements. For sortation, BHSC shall demonstrate the proper sortation of 200 items. Items can be bags tubs, wood blocks, etc. or combinations of these items.
- j. Demonstration of system(s) Fault Monitoring, System Status Panel.
- k. BHSC shall demonstrate the operation and functionality of all computer and PLC programming.
- l. BHSC shall demonstrate all interfaces with other systems. BHSC shall coordinate interface demonstration with all parties involved.
- m. Commissioning (Pre-ISAT) Testing:
 - 1) For systems that interface with Explosive Detection System Equipment, BHSC must demonstrate the system in accordance with the TSA approved ILDT Test Plan, developed by the BHSC and ILDT, to the Owner’s representatives. Coordinate with EDS OEM in support of integration activities (e.g. installation and testing the required software and hardware to allow for digital and serial communication between the EDS and BHS PLC) as needed. Passage of this testing in no way relieves responsibility for corrections of noted discrepancies during this testing or subsequent testing.

4.4.C. Commissioning Plan:

- 1. The BHSC shall provide a Commissioning Plan for each system(s), which shall, at minimum, incorporate the requirements listed above in the Commissioning - Demonstration and Testing section in this Specification.
- 2. The material to be used for all necessary tests, plus personnel to handle it, shall be provided by the BHSC. The BHSC shall have all personnel and a representative identified by the Owner “on site” during all periods of the system(s) Commissioning Demonstration. All tests shall be conducted with bags, tubs, blocks, etc. or combinations of these items; and at Owner’s option with laded cartons to supplement available baggage. The BHSC shall identify a list of items in the test plan. The Commissioning Plan shall be submitted by BHSC for Owner’s review and approval 60 calendar days prior to the start-up of commissioning.
- 3. The BHSC shall provide all necessary testing, measuring, and recording devices required to demonstrate the operational characteristics and performance of the equipment to the satisfaction of The Authority. At a minimum, the required test equipment shall include: Fluke Three-Phase Power Logger 1735 with a laptop (for load test), Clamp-on type ammeter (not for load test), direct read F.P.M. digital readout Tachometer, etc. All testing, measuring and recording devices shall be calibrated and certified by an independent third-party testing company which is acceptable to The Authority; each calibration certificate of each device shall be submitted with the Commissioning Plan.

4.4.D. Commissioning Test Failure:

1. A failure during any commissioning test period shall be defined as any design characteristic or malfunction of the BHSC furnished equipment or materials that damages baggage or results in an operating rate below those specified. Conditions resulting from improper loading of baggage or loading baggage of sizes not included in the Specification requirements will not be considered as failures.

4.5 TEST READINESS REVIEW (TTR):

4.5.A. Coordinate with TSA Site Lead Coordinator as necessary to assure TSA of the site readiness for ISAT. BHSC must demonstrate the system in accordance with the approved ILDT Test Plan to the TSA Site Lead Coordinator. Upon successful completion, the TSA Site Lead Coordinate will issue a Testing Readiness Notification (TRN) notify TSA Headquarters that the system is ready for the ISAT, at which time the TSA schedule and deploy its Acceptance Test Contractor.

4.5.B. ILDT Test Plan:

1. ILDT Test Plan shall be as specified in the PGDS and shall incorporate requirements from the BHSC and ILDT (Owner, Owner's Representatives, Airlines, Law Enforcement, TSA Local and HQ, and Design Team) in accordance with the PGDS. Test Plan shall include, but is not limited to, the following as identified in the PGDS:

a. Introductory Testing:

- 1) CBRA Equipment and Functionality Test as per PGDS as per PGDS.
 - a) Part 1 - Normal Queueing and Automated Re-Insertion as per PGDS.
 - b) Part 2 - AQM and Manual Re-Insertion as per PGDS.
 - c) Part 3 - Resumption of Normal Queueing, BIS E-Stops, and Other Display Assessment as per PGDS.
- 2) Travel Time/On-Screen Resolution Test as per PGDS.
- 3) Over-Height Bag Test. as per PGDS.
- 4) Over-Width Bag Test. as per PGDS.
- 5) Over-Length Bag Test as per PGDS.
- 6) Out-of-Gauge/Lost Bag Routing Test as per PGDS.
- 7) Duplicated IATA/RFID Tag Test as per PGDS.
- 8) Mixed Bag Line Test as per PGDS.
- 9) PLC versus Upper Level Sort Test as per PGDS.
- 10) Clear Bag Bypass Test as per PGDS.

- b. Detailed Testing:
 - 1) Removed Bag Test as per PGDS.
 - 2) Delayed Bag Test as per PGDS.
 - 3) Accelerated Bag Test as per PGDS.
 - 4) Added Bag Test as per PGDS.
 - 5) Bag Spacing Test as per PGDS.
 - 6) E-Stop Test as per PGDS.
 - a) BHS E-Stop Test as per PGDS.
 - b) EDS E-Stop Test as per PGDS.
 - 7) Halt/Fail-Safe Test as per PGDS.
 - 8) Fail-Safe Operation for In-Line CBIS as per PGDS.
 - 9) Fail-Safe Operation for Mini In-Line CBIS with a Manually Operated In-Line Decision Point as per PGDS.
 - 10) EDS Entrance Jam Recovery Test (Continuous Feed EDS only) as per PGDS.
 - 11) EDS Exit Jam Recovery Test (Continuous Feed EDS only) as per PGDS.
 - 12) Decision Expiration Functionality Test as per PGDS.
 - 13) Operational Test Kit Functionality Test as per PGDS.
 - 14) Crossover Test
 - c. System-wide Testing:
 - 1) Full Load Test as per PGDS.
 - 2) System Throughput Test as per PGDS.
 - d. Operational Run-In as per PGDS.
2. ILDT Test Plan shall be submitted to TSA and TSA's representatives for review, comment, and approval as required by the PGDS.

4.6 INTEGRATION SITE ACCEPTANCE TEST (ISAT):

- 4.6.A. BHSC and BHS Programmer are to provide personnel to operate BHS during ISAT and provide support for ISAT testing and diagnostic activities.

- 4.6.B. BHSC shall meet with the TSA Acceptance Test Contractor prior to testing to coordinate the conduct of ISAT testing. Coordinate with TSA Acceptance Lead to finalize details relating to the scheduling and duration of the testing.
- 4.6.C. ISAT will be per TSA's Site Specific Test Plan (SSTP), which will not be provided to the BHSC or ILDT due to its sensitive nature. However, it will be similar to the approved ILDT Test Plan per the PGDS.
- 4.6.D. Upon completion of the ISAT, TSA will review findings from the TSA Acceptance Test Contractor and issue a Quick Look Report (QLR) identifying the status of the ISAT and CBIS and then a Test Summary Report (TSR) identifying the status and any deficiencies that were observed during the ISAT. If ISAT passed, the testing will proceed to the Operational Run-In period. Any deficiencies per the TSR will be required to be rectified by the BHSC, General Contractor, and/or ILDT. If ISAT did not pass, the deficiencies must be corrected and tested, and a re-ISAT must take place.

4.7 OPERATIONAL RUN-IN:

- 4.7.A. BHSC shall coordinate with TSA and its Acceptance Test Contractor to forward electronic versions of all CBIS Reports required by PGDS to the TSA and its Acceptance Test Contractor. BHSC shall coordinate with the TSA Site Lead to perform any required operational changes to CBIS as the result of the TSA's Test Summary Report (TSR).
- 4.7.B. If the system passes the Operational Run-In, then the CBIS will proceed to TSA Closeout as specified in the PGDS.

PART-5 GENERAL WARRANTY:

5.1 WARRANTY PERIOD:

- 5.1.A. The warranty period for the Baggage Handling System shall commence upon Beneficial Use of any system or subsystem.
- 5.1.B. The warranty period for the entire Baggage Handling System shall extend for a period of one (1) year from the date of Beneficial Use of the last system or subsystem with the Owner's option to enter into four one-year extensions.
- 5.1.C. Manufacturer's warranties on equipment that are longer than the system warranty shall be turned over to the Owner and documented in the warranty agreement.

5.2 WARRANTY REQUIREMENTS:

- 5.2.A. In addition to the warranty requirements of the General Conditions and Specification Section 01 78 00; the warranty shall comply with the following requirements. The baggage handling system(s) shall be warranted jointly and severally, on a single document, by the Baggage Systems Contractor, Installer, and Designer/Manufacturer for complete operating baggage systems as specified herein and agreeing to repair or replace defective materials and workmanship of the work during the warranty period, which starts on the date of beneficial use or substantial completion, whichever occurs first. Defective materials and workmanship is hereby defined to include operational failure, performance below required minimums, excessive deterioration or aging, abnormal wear considering intensity of use, unsafe conditions, excessive noise or vibration and similar unusual, unexpected and unsatisfactory conditions; In the event that the above defects occur within the warranty period, the BHSC shall repair or replace the defective item(s) and assume full costs of labor and materials for such replacement. Replacement item(s) shall be new and meet the requirements of this specification. The above does not include defects caused by acts of nature, alterations, abusive use, vandalism, and similar cases beyond the control of the Baggage Systems Contractor, Installer, and Designer/Manufacturer.

5.3 DESIGN FAILURE:

- 5.3.A. In the event that a design failure occurs during the warranty period, the BHSC shall redesign/re-select and replace all components, assemblies, and/or devices utilized in and contributing to the failed design at no cost to the Owner. Submit proposed redesign shop drawings and component data sheets to Owner's representative for approval. BHSC shall provide a new warranty period for the system upon the correction of such design failure. Components, assemblies, and/or devices shall be considered as design failures if any of the following occurs during the warranty period:
 - 1. Inappropriate action of the BHS mechanical functions or control system components during operational conditions.
 - 2. Discovering of an imminent safety hazard or occurrence of an accident during operational conditions attributable to the design of the system. Occurrence of an accident shall be investigated and determination on the cause of the accident shall be performed a third party.
 - a. Failure to meet "System Reliability" requirements herein after the system has been run in.

5.4 WARRANTY PROCEDURES:

5.4.A. BHSC shall submit their standard warranty procedures that conform to the requirements of the owner's warranty department. Owner may add additional requirements to meet the Airport's maintenance department needs. Warranty procedures shall include, but not limited to, the following:

1. Conditions for Claims (scheduled, imminent, and emergency).
2. Repairs made by the Owner's personnel.

5.4.B. BHSC shall include in their warranty procedures (but not limited to):

1. On-site inspections (twice a month) for preventative maintenance of the system (mechanical, electrical, and controls).
2. Keeping a log of inspections. The log shall be available to the owner's maintenance team at any time.
3. Keeping a schedule of anticipated adjustments, replacements, and fixes to the components of the BHS and the date of the maintenance. The schedule shall be available to the owner's maintenance team at any time.
4. Dial-in ability to make modifications to controls code.

PART-6 BID ALTERNATES:

6.1 ALTERNATE 1 - CURBSIDE CONVEYOR LINE:

- 6.1.A. Provide a Cost for the provision of the curbside conveyor line (for Alternate 1 on the BID FORM). The curbside line of Alternate 1 shall be configured as shown on the BHS contract documents. The Cost shall include the provision of all necessary systems elements to provide a complete operational subsystem as defined in the BHS contract documents.
- 6.1.B. The Curbside conveyor line shall include the defined conveyor segments, security door, control stations, MCP with alarm beacons and OIT, PLC controls (including merge coordination with the Ticket Counter conveyor line) and all functional requirements for BHS/project components of this specification.

6.2 ALTERNATE 2 – EXTENDED MAINTENANCE PERIOD:

- 6.2.A. Provide price for 4 years of Maintenance to commence at the end of the First Year of Maintenance Services. This price will not be included as part of the Basis of Award.
- 6.2.B. The Extended Maintenance period requirements shall include:
1. Providing a team of a minimum of two Maintenance personnel for work in off-peak hours. These shall include:
 - a. A shift supervisor,
 - b. Staff to support the shift supervisor's efforts,
 - c. The supervisors shall have a minimum of 2 years' experience relating to mechanical/electrical/PLC-controlled system.
 - d. The support staff shall have a minimum of 1 years' experience relating to mechanical/electrical/PLC-controlled system.
 2. Maintenance personnel to provide multiple shifts of labor to cover the operational hours of the airport, to include:
 - a. Providing preventative maintenance as defined in section 1.15 D above
 - b. Providing unscheduled maintenance to keep the system operational; to include operational failure, performance below required minimums, excessive deterioration or aging, abnormal wear considering intensity of use, unsafe conditions, excessive noise or vibration and similar unusual, unexpected and unsatisfactory conditions, but shall not include defects caused by acts of nature, alterations, abusive use, and vandalism.
 - c. Replenishment of spare parts.
 - d. Responding to critical issues within 24 hours.

END OF SECTION 34 77 39