



City of Houston - Department of Aviation – Infrastructure Division

**ATTACHMENT - B**

**TECHNICAL SPECIFICATIONS**

**PLB REPLACEMENT**

**HOUSTON AIRPORT SYSTEM**

**WILLIAM P. HOBBY AIRPORT**

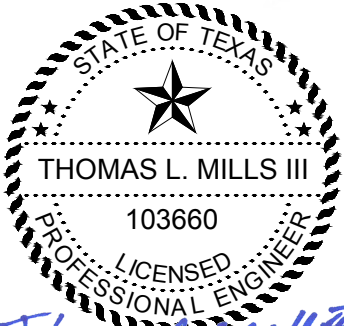



**PROJECT No.: PN946B**

**ISSUED FOR BID**

**APRIL 04, 2022**

Jacobs Engineering Group Inc.  
5985 Rogerdale Road, Tower II, 3<sup>rd</sup> Floor  
Houston, TX 77072  
(281) 721-8500  
TBPE Firm Registration No. F-2966

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<b>SEALS PAGE</b> PLB Replacement and New Installations	
<p>Civil (CSPP) Jacobs Engineering Group Inc.</p>  <p>04-04-2022 TBPE FIRM NUMBER F-2966</p>	<p>Architectural Jacobs Engineering Group Inc.</p>  <p>04-04-2022 TBPE FIRM NUMBER F-2966</p>
<p>Electrical Jacobs Engineering Group Inc.</p>  <p>04-04-2022 TBPE FIRM NUMBER F-2966</p>	<p>Mechanical/Plumbing Jacobs Engineering Group Inc.</p>  <p>04-04-2022 TBPE FIRM NUMBER F-2966</p>

IT/Telecom  
4B Technology



TBPE FIRM NUMBER F-2966

Civil (Passenger Loading Bridge)  
Jacobs Engineering Group Inc.



TBPE FIRM NUMBER F-2966



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LIST OF DRAWINGS

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**SECTION 01110**  
**SUMMARY OF WORK**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Project description.
- B. Work description.
- C. City occupancy.
- D. Contractor-salvaged products.
- E. Separate contracts and work by City.
- F. Extra copies of Contract Documents.
- G. Permits, fees and notices.

**1.02 THE PROJECT**

The Project is the William P. Hobby Airport/ Houston in Houston, Texas.

**1.03 GENERAL DESCRIPTION OF THE WORK**

- A. Construct the Work under multiple separate construction contracts under a single construction management contract as follows:

*Project Description*

The Houston Airport System (HAS) has a continuing capital renewal and redevelopment program. A component of this program includes installation of new Passenger Loading Bridges (PLB), Pre-Conditioned Air Units (PCA), and Ground Power Units (GPU) William P. Hobby Airport (HOU).

The Overall Development Objective (ODO) of this project is to replace 5 older PLBs at Gates 28, 29, 30, 31, and 32 at William P. Hobby Airport (HOU) with new modernized PLBs, Ground Power Units (GPUs), and Pre-Conditioned Air Units (PCAs).

This document addresses the ODO to be undertaken by HAS, replacing 5 PLBs, GPUs, and PCAs.

**SUMMARY OF WORK**

The scope of work for the PLB replacement project will include:

1. Disconnecting electrical equipment from existing PLBs and reconnecting to new Passenger Loading Bridges.
2. Demolish existing disconnect switch serving 400Hz GPU and made safe for reconnection to new disconnect switches.
3. Demolish existing disconnect switch serving PCA. Existing circuit to be demolished back to panel. Breaker to be placed in off position.
4. Demolish existing disconnect switch serving the PLB. Existing circuit to be made safe for reconnection to new disconnect switches.
5. Demolition and Removal of existing PLBs, GPUs, and PCAs at Gates 28, 29, 30, 31, and 32. Fixed walkways and existing foundation/pier to remain.
6. Install new disconnect for 400Hz.
7. Install new circuit and disconnect for PCA.
8. Install new disconnect for PLB.
9. Route Condensate from PCA unit back to existing drain. Flush and clean existing drain line prior to connection.
10. Existing potable water cabinet to remain and reused. Flush and clean existing lines.
11. Demolish network cables from PLB interface back to termination point. Demolish PLB interface box.
12. Install stainless steel NEMA 4 interface box with hinged door.
13. Rout 1" conduit to each PLB Rotunda.
14. Terminate CAT 6 cable in IT Data Cabinet.
15. Tie existing 1" conduit into stainless steel NEMA enclosure.
16. Existing 1" conduit back to IDF to remain.
17. Install 1" conduit to PLB travel cable. Coordinate exact size and route with PLB contractor.
18. Remove existing PLBs, GPUs and PCAs.
19. Install new PLBs, GPUs, and PCAs and re-connect to electrical, plumbing and IT/Telecom.

B. Notice to Proceed

Following Contract Execution, the Contractor will be given an Administrative Notice to Proceed, which will include Mobilization, Operations Coordination, Approved Submittals, Request for Information (if any), Badging, Safety Training, and other requirements as needed to prepare for the Construction Work. Administrative NTP timeframe is estimated for an amount time of 90 days. Upon completion of pre-construction preparedness, HAS will issue a Construction Notice to Proceed.

C. The Work is summarized as construction of PLB Replacement and New Installations

**SUMMARY OF WORK**

SUMMARY OF WORK

1. Cut and patch existing construction designated or required to remain and to receive new construction, following Section 01731- Cutting and Patching, and Section 01761 – Protection of Existing Services.

- D. Contract limit lines are shown diagrammatically on Drawings.
- E. The estimated total cost of construction for this project is \$7,000,000.

1.04 CITY OCCUPANCY

The City will occupy the premises and remain in operation during the entire period of construction.

- A. Cooperate with the City to reduce conflict, and to facilitate the City's operations. Coordinate Contractor's activities with City Operations or Maintenance personnel through City Engineer.
- B. Schedule Work to fit these requirements.

1.05 CONTRACTOR-SALVAGED PRODUCTS (CSP)

- A. Products intended for salvage and return by the Contractor to City Engineer are scheduled in Part 2 of this Section and are shown in diagrammatic form or noted on Drawings.
- B. Obtain, handle, store and protect CSP following Section 01731 - Cutting and Patching. Reinstall items designated for reuse following Section 01731.
- C. Provide written receipt or transfer of title to City Engineer.
- D. Assume CSP function properly, unless discovered to the contrary and notice given before removal. Correct damages or deficiencies occurring to CSP while in possession of Contractor, without change in Contract Sum or Time.

1.07 EXTRA COPIES OF CONTRACT DOCUMENTS

Use reproducible documents, furnished by City following Document 00700 Paragraph 2.2.2, to make extra copies of Contract Documents (dialo prints of Drawings and electrostatic copies of Project Manual) as required by Contractor for construction operations, and for Contractor's records following Sections 01726 - Base Facility Survey and 01770 - Contract Closeout. Follow Document 00700 Paragraph 1.3.

1.08 PERMITS, FEES AND NOTICES

Refer to Document 00700 Paragraph 3.14. Reimburse City for City's payment of fines levied against City or its employees because of Contractor's failure to obtain proper permits, pay proper fees, and make proper notifications. Reimbursement will be by Change Order, reducing the Contract Price as based upon the dollar amount of fines imposed.

**SUMMARY OF WORK**

PART 2 PRODUCTS

2.01 SCHEDULE OF CSP

- A. Unless indicated otherwise, salvage and return to the City the following CSP existing within the contract limits:
  - 1. Ground Power Units (GPUs)
  - 2. Pre-Conditioned Air Units (PCAs)
- B. Return excess CSP items following Section 01770 - Contract Closeout.

PART 3 EXECUTION (NOT USED)

END OF SECTION



**SECTION 01145**  
**CONTRACTOR'S USE OF PREMISES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Rights-of-way and access to the Work.
- B. Property and Base Facility outside contract limits.
- C. General requirements for exterior work.
- D. Work in AOA, including electrical lockout/tagout program.
- E. Interior work.
- F. Control of access into security areas.

1.02 SUBMITTALS

- A. Show start dates and duration of closures and impediments on construction schedule following Section 01325 - Construction Schedules.
- B. Prepare written requests, using Document 00931 - Request for Information, and submit requests at least 7 days before access is required, for following:
  - 1. Roadway, street, driveway, curbside and building main entrance/exit closures or impediments. Do not close or impede emergency exits intended to remain.
  - 2. Access to property outside contract limits, required to extend or connect work to utilities or environmental system controls in non-contract areas.
- C. For work involving electrical energy or other hazardous energy sources, submit a Lockout/Tagout Program.

1.03 RIGHTS-OF-WAY AND ACCESS TO THE WORK

- A. Confine access and operations and storage areas to contract limits and other areas provided by City, following Document 00700. Do not trespass on non-City-owned property or on airport occupants' spaces.
- B. Airport operates "around the clock." In cases of conflicts with construction operations, airport operations take precedence. Airport roads, streets, drives, curbsides and sidewalks, and ticketing, baggage claim, security check points, concessions, restrooms, aircraft gates

**CONTRACTOR'S USE OF PREMISES**

**CONTRACTOR'S USE OF PREMISES**

and similar passenger-related areas are intended for year-round uninterrupted use and access by the public and airport operations. Maintain uninterrupted traffic movement.

1. Aircraft and emergency vehicles have right-of-way in AOA.
  2. Private vehicles, public transportation and emergency vehicles have right-of-way on roads, streets, driveways and curbsides.
  3. Passengers have right-of-way in public spaces. Occupants have right-of-way in other occupied areas.
- C. Follow instructions of the City Engineer, Airport Manager and of ATCT. Follow FAA procedures.
- D. FAA will review Contractor's submittals for compliance with FAA requirements. Attend meetings with FAA to assist the City Engineer in obtaining approvals.
- E. Continued violations of or flagrant disregard for policies may be considered default, and individuals disregarding requirements may be determined as objectionable by the City Engineer, following provisions of Document 00700.

Do not close or impede rights-of-way without City Engineer approval.

- F. City Engineer may approve temporary storage of products, in addition to areas shown on Drawings, and other on-airport areas if storage piles do not interfere with airport operations.
1. No permission will be granted for this type of storage in Terminal roadway areas.

**1.04 PROPERTY AND BASE FACILITY OUTSIDE CONTRACT LIMITS**

- A. Do not alter condition of property or Base Facility outside contract limits.
- B. Means, methods, techniques, sequences, or procedures which may result in damage to property outside of contract limits are not permitted.
- C. Repair or replace damage to property outside contract limits to condition existing at start of the Work, or better.

**1.05 GENERAL REQUIREMENTS FOR EXTERIOR WORK**

- A. Obtain permits and City Engineer's approval prior to impeding or closing roadways, streets, driveways, Terminal curbsides and parking areas.
- B. Maintain emergency vehicle access to the Work and to fire hydrants, following Section 01505 - Temporary Facilities.

**CONTRACTOR'S USE OF PREMISES**

**CONTRACTOR'S USE OF PREMISES**

- C. Do not obstruct drainage ditches or inlets. When obstruction is unavoidable due to requirements of the Work, provide grading and temporary drainage structures to maintain unimpeded flow.
- D. Locate by Section 01726 - Base Facility Survey and protect by Section 01505 - Temporary Facilities communications or data systems and direct-buried lines which may exist. Repair or replace damaged systems to condition existing at start of Work, or better.
- E. Public, Temporary, and Construction Roads and Ramps:
  - 1. Construct and maintain temporary detours, ramps, and roads to provide for normal public traffic flow when use of public roads or streets is closed by necessities of the Work.
  - 2. Provide mats or other means to prevent overloading or damage to existing roadways from tracked equipment or exceptionally large or heavy trucks or equipment.
  - 3. Construct and maintain access roads and parking areas following Section 01505 - Temporary Facilities.
- F. Excavation in Streets and Driveways:
  - 1. Do not hinder or needlessly impede public travel on roadways, streets or driveways for more than two blocks at any one time, except as approved by City Engineer.
  - 2. Obtain the City Traffic Management and Maintenance Department and City Engineer's approval when the Work requires closing of off-airport roadways, streets or driveways. Do not unnecessarily impede abutting property.
  - 3. Remove surplus materials and debris and open each block for public use as work in that block is complete. Acceptance of any portion of the Work will not be based on return of street to public use.
  - 4. Provide temporary crossings, or complete work in one continuous operation. Minimize duration of obstructions and impediments at drives or entrances.
- G. Provide barricades and signs following Sections 01505 - Temporary Facilities and 01507 - Temporary Signs.
- H. Traffic Control: Follow Section 01555 - Traffic Control and Regulation.
- I. Surface Restoration:
  - 2. Restore site to condition existing before construction, following Section 01731 - Cutting and Patching, to satisfaction of City Engineer.

2.06 WORK IN AOA

**CONTRACTOR'S USE OF PREMISES**

**CONTRACTOR'S USE OF PREMISES**

- A. If construction requires closing of safety areas of runways, taxiways and aprons and those closings are not already indicated on the Drawings, then submit such request in writing on a separate document in the Safety Plan. Closings require NOTAMs (Section 01423 - References).
- B. Open trenches are generally not permitted in areas of aircraft and GSE movement. Exceptions may be approved by the Airport Manager and by FAA.  
  
Barricade, light and mark the edges of permitted open trenches and excavations as directed.
- C. Flares are not permitted in the AOA.
- D. Do not obliterate runway and taxiway markings, unless required as part of the Work. Repair or replace damaged markings with matching color, material and copy where resulting from work of this contract.
- E. Open-flame welding and cutting in the AOA is discouraged. When unavoidable, obtain case-by-case approval. Provide proper fire control equipment, approved by Fire Department/ Aviation Section.
- F. Hearing protection is recommended for persons in the AOA.
- G. Do not store products in safety areas of runways, taxiways or aprons or in runway overruns and clear zones for more than then-active one-day operation. Provide large and long-term storage outside the AOA.
- H. Follow lockout/tagout program below.
  - 1. Electrical Lockout/Tagout for HAS Projects:
    - a. AOA has underground lighting and control cables. Known cables are shown (charted) on Drawings.
    - b. Survey area within contract limits following Section 01726 - Base Facility Survey, using proper equipment, to confirm location of charted cables and cables discovered during survey. Stake locations.
    - c. Notify City Engineer and Airport Manager in daily briefings (Section 01312 - Coordination and Meetings) before excavation in the vicinity of charted or discovered cables. Make written request for deactivation and reactivation of circuits.
    - d. Deactivation and reactivation of circuits is the responsibility of the Airport Manager.

**CONTRACTOR'S USE OF PREMISES**

**CONTRACTOR'S USE OF PREMISES**

- e. Furnish proper personnel, cable locating instruments, tools, splice kits, cable and other products at the time excavation work is underway, for cable repair as required.
  - f. Excavate, make cable repairs, cover repairs, and backfill excavation at repaired cables an only in presence of City Engineer and Airport Manager.
  - g. Immediately report discovered or detected outages to City Engineer and Airport Manager.
  - h. Follow repair details shown on Drawings. If details are not consistent with existing or discovered conditions, or if required repairs cannot be properly made, submit Document 00931 following Section 01255 - Modification Procedures.
  - i. Record repairs following Section 01770 - Contract Closeout.
  - j. Test proper operation of circuits, in presence of City Engineer and Airport Manager, before covering repairs. Follow Section 01450 - Contractor's Quality Control. Immediately correct failures.
  - k. Airport Manager will perform a daily check of circuits in vicinity of construction at 1500 hours to confirm proper operation. Immediately correct failures.
2. Electrical Lockout/Tagout: Follow OSHA 29 CFR 1910.331.
- I. Construction near NAVAIDS and ARFF:
- 1. Do not obstruct line of sight from ATCT or interfere with transmissions from NAVAIDS.
  - 2. Do not obstruct exits or entrances to ARFF.
- 1.07 GENERAL REQUIREMENTS FOR INTERIOR WORK
- A. Obtain City Engineer's approval and permits prior to impeding or closing building entrances, corridors, and areas around passenger service functions (ticketing, baggage check and claim, security screening, waiting, aircraft enplaning and deplaning).
  - B. Maintain emergency access to the Work and to fire hose and extinguisher cabinets, following Section 01505 - Temporary Facilities.
  - C. Do not obstruct fire exits. When obstruction is unavoidable due to requirements of the Work, provide fire-retardant enclosures to maintain unimpeded flow, following Section 01505 - Temporary Facilities.
  - D. Locate by Section 01726 - Cutting and Patching and protect by Section 01505 - Temporary Facilities utility and communications or data systems which may exist. Repair or replace damaged systems to condition existing at start of Work, or better.

**CONTRACTOR'S USE OF PREMISES**

**CONTRACTOR'S USE OF PREMISES**

- E. Provide temporary facilities and controls following Section 01505 - Temporary Facilities.
  - F. Provide signs following Section 01507 - Temporary Signs.
- 1.08 CONTROL OF SECURITY AREA ACCESS
- A. Install barricades and enclosures to prevent uncontrolled access into security areas, following Section 01505 - Temporary Facilities. Provide locked access points. Provide duplicate keys to City Engineer.
  - B. Post one gatekeeper, employed by the Contractor, at each point of access through barricades or enclosures into security areas, during times when access points are not locked. Ensure persons entering are properly badged.
  - C. Provide signs following Section 01507 - Temporary Signs.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01210**  
**CASH ALLOWANCES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. City's allowances allocated to the items of work listed or as directed.
- B. See Document 00700 - General Conditions, Paragraph 3.11 for costs included and excluded from cash allowance values listed in 1.02 below.
- C. Follow Section 01255 - Modification Procedures for processing allowance expenditures. Cash Allowance sums remaining at Final Completion belong to the City, creditable by Change Order.

1.02 SCHEDULE OF CASH ALLOWANCES (TOTAL \$ **X,XXX** VALUE)

- A. Allowance Item 1 - Building Permit: For obtaining the Building Permit from City of Houston, \$ **X,XXX**.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01230**  
**ALTERNATES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Descriptions of alternate work.

Unless otherwise stated in the Bid Documents, alternates are intended as additive.

- B. Alternates are for complete work, in place and ready for use, following the Contract Documents.
- C. Volunteer Alternates, any Alternate not specified in this Section, will not be considered. Submit requests for substitution of products and processes following Document 00700 and Section 01610 - Basic Product Requirements.

1.02 ACCEPTANCE OF ALTERNATES AND BID PRICES

- A. State in Document 00405 - Bid Tabulation Form the Bid Price for each Alternate.
- B. Bid Price for each Alternate will be reviewed, and work of each Alternate accepted or declined at City's option.
- C. Lowest Total Bid Price will be evaluated on the basis of Base Bid Price plus all Alternates.
- D. After determination of lowest Bidder, City will determine which, if any, Alternates to accept.
- E. After acceptance of Alternates, Total Bid Price will be adjusted accordingly, and the appropriate Total Contract Price entered in Document 00510 - Agreement prior to execution.

1.03 SCHEDULE OF ALTERNATES

- A. Alternate No. 1: [Brief description \_\_\_\_\_]: Refer to Specification Sections [\_\_\_], [\_\_\_], and [\_\_\_], and Drawings Numbered [\_\_\_], [\_\_\_], and [\_\_\_] including referenced details.
- B. (Continue listings of Alternates as appropriate)

PART 2 PRODUCTS (NOT USED)

**ALTERNATES**



PLB Replacement  
Project No. PN946B

Issued for Bid Documents  
04/04/2022  
ALTERNATES

PART 3 EXECUTION (NOT USED)

END OF SECTION

**ALTERNATES**

**01230-2** ver. 12.27.17

**SECTION 01241  
CONTRACTOR'S VALUE ENGINEERING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Procedures for Contractor proposing construction cost reductions for projects exceeding \$100,000.00 in original contract value.
1. Following work is not eligible for value engineering:
    - a. Basic design of a pavement type.
    - b. Runway and taxiway lighting.
    - c. Visual aids.
    - d. Hydraulic capacity of drainage facilities.
    - e. Grade or alignment that reduces the geometric standards of the Work.
  2. Do not propose value engineering if resulting work will 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, or increase contract value or time.
- B. City's procedures for review and approval of Contractor's proposals.

**1.02 DEFINITIONS**

- A. *Net Savings*: The difference in costs between the original contract value, as agreed by Contractor and City Engineer, for original work related to value engineering and the costs resulting from actual value-engineered work.

**1.03 SUBMITTALS**

- A. Five copies of Document 00931 - Request for Information specifically identified as a value engineering proposal, and including:
1. Written description of both then-current contract requirements.
  2. Written description of proposed changes, with documentation following Section 01630 - Product Options and Substitutions.

**CONTRACTOR'S VALUE ENGINEERING**

3. Statement of the period of time the proposal is valid, and statement of the time by which a change order incorporating the proposal must be executed.
4. Detailed estimate of the cost of performing work under the then-current contract and under the proposed change.
5. Statement of the effect adoption of the proposal will have on the time for completion of the contract.
6. Items of work affected by the proposed changes, including quantity variation attributable to changes.

1.04 PROCEDURES FOR SUBMITTAL, REVIEW AND NOTICE OF ACCEPTANCE

- A. Prepare and submit documentation following Paragraph 1.03.
- B. Continue to perform work following then current Contract Documents during City's review.
- C. City Engineer or Designer or both will review proposals and indicate decisions thereon following Section 01630 - Product Options and Substitutions.
- D. Notice of acceptance of value engineering proposals will be made by City Engineer by issuance of an appropriate form of contract modification, including revisions to Contract Documents as required to describe changes, following Section 01255 - Modification Procedures, and specifically stating that it is executed pursuant to this Section.

1.05 COST SHARING

- A. The Contractor shall share 50 percent of City's costs of investigating value-engineering proposals, deducting that value from change orders attributable to value-engineered work.
- B. The Contractor shall share 50 percent of the value of net savings resulting from value-engineered work, creditable by change orders corresponding to the value-engineered work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01255**  
**MODIFICATION PROCEDURES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Signatories on behalf of City and Contractor.
- B. Contractor's documentation.
- C. Change Orders.
- D. Requests for Proposal.
- E. Work Change Directives.
- F. Execution of Modifications.
- G. Resolving Discrepancies.
- H. Requests for Information or Clarification.
- I. Correlation of Submittals.

1.02 SIGNATORIES

- A. Submit at the Preconstruction Conference (Section 01312 - Coordination and Meetings) a letter indicating the name and address of Contractor's personnel authorized to execute Modifications, and with responsibility for informing others in Contractor's employ or Subcontractors of same.

1.03 REFERENCES

- A. Blue Book: "Dataquest" Rental Rate Blue Book for Construction Equipment.
- B. Rental Rate: The full unadjusted base rental rate for the applicable item of equipment.

**MODIFICATION PROCEDURES**

**MODIFICATION PROCEDURES**

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1.04 CONTRACTOR'S DOCUMENTATION

- A. Maintain detailed records of changes in the Work. Provide full information required for identification and evaluation of proposed changes, and to substantiate costs of changes in the Work.
- B. Furnish sufficient data to allow City Engineer's evaluation of Contractor's responses to proposed changes.
- C. Include with each proposal the following minimum information (as applicable to form of Contract Price):
  - 1. Quantities of original Bid Schedule unit price work items (with additions, reductions, deletions, and substitutions).
  - 2. When work items are not included in Document 00410 - Bid Tabulation Form, provide unit prices for the new items, with proper supporting information.
  - 3. For Stipulated Price changes, furnish breakdown of labor, products, taxes, insurance, bonds, temporary facilities and controls as applicable, and overhead and profit.
  - 4. Justification for change, if any, in Contract Time.
  - 5. Additional data upon request.
- D. Payment for rented equipment will be made to the Contractor by actual invoice cost for the duration of time required to complete additional work. If additional work comprises only a portion of the rental invoice where the equipment would otherwise be on the site, compute the hourly equipment rate by dividing the actual monthly invoice by 176. (One day equals 8 hours and one week equals 40 hours.) Operating costs shall not exceed the estimated operating costs given for the item of equipment in the Blue Book.
- E. For changes in the Work performed on a time-and-materials basis using Contractor-owned equipment, compute rates with the Blue Book as follows:
  - 1. Multiply the appropriate Rental Rate (the lowest cost combination of hourly, daily, weekly or monthly rates) by an adjustment factor of 70 percent plus the full rate shown for operating costs. Use 150 percent of the Rental Rate for double shifts (one extra shift per day) and 200 percent of the Rental Rate for more than two shifts per day. No other rate adjustments apply.
  - 2. Standby Rates: 50 percent of the appropriate Rental Rate shown in the Blue Book. Operating costs are allowed.

1.05 CHANGE ORDERS

**MODIFICATION PROCEDURES**

**MODIFICATION PROCEDURES**

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- A. Changes to Contract Price or Time are made only by execution of a Change Order.
- B. Stipulated Price Change Order: Stipulated Price Change Orders are based on an accepted Proposal/Contract Modification including the Contractor's lump sum price quotation.
- C. Unit Price Change Order:
  - 1. Where Unit Prices for the affected items of Work are included in Document 00410 - Bid Tabulation Form, Unit Price Change Orders are based on unit prices as originally bid, subject to requirements in Articles 7 and 9 of Document 00700 - General Conditions.
  - 2. Where unit prices of Work are not pre-determined in Document 00410 - Bid Tabulation Form, Request for Proposal or Work Change Directive will state the unit prices to use.
- D. Time-And-Material Change Order:
  - 1. Provide an itemized account and supporting data after completion of change, within time limits indicated for claims in Document 00700 - General Conditions.
  - 2. City Engineer will determine the change allowable in Contract Price and Contract Time following Document 00700 - General Conditions.
  - 3. For changes in the Work performed on a time-and-material basis, furnish the following in addition to information specified in Paragraph 1.04.C:
    - a. Quantities and description of products and tools.
    - b. Taxes, insurance and bonds.
    - c. Overhead and profit, following Document 00700 - General Conditions Paragraphs 7.3.2.2.6 or Document 00800 - Supplementary Conditions.
    - d. Dates and times of work performance, and by whom.
    - e. Time records and certified copies of applicable payrolls.
    - f. Invoices and receipts for products, rented tools, and Subcontracts, similarly documented.

1.06 REQUEST FOR PROPOSAL

- A. City Engineer may issue a Request for Proposal, including a detailed description of proposed changes, supported by revised Drawings and Specifications, if applicable. Prepare and submit Contractor's response to the Request for Proposal within 7 days or as specified in the request.
- B. This document does not authorize work to proceed.
- C. Follow instructions on back of the Request for Proposal.

**MODIFICATION PROCEDURES**

**MODIFICATION PROCEDURES**

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1.07 WORK CHANGE DIRECTIVE (WCD)

- A. City Engineer may issue a WCD instructing the Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
- B. City Engineer may issue minor changes in the Work, not involving an adjustment to Contract Price or Time by using a WCD.
- C. The document will describe changes in the Work and will designate a method of determining change, if any, in Contract Price or Time. When properly executed, this document authorizes work to proceed. Follow instructions on back of the WCD.
- D. Promptly execute changes in the Work following the directions from the Work Change Directive.

1.08 RESOLVING DISCREPANCIES

- A. Complete Base Facility survey following Section 01726 - Base Facility Survey prior to preparation of submittal data and commencing main construction operations. Submit survey data of inaccessible concealed conditions as cutting and patching or demolition operations proceed.
- B. Prepare and submit a Request for Information for each separate condition with a written statement of substantive discrepancies, including specific scope, location and discrepancy discovered.
- C. Based upon the Contractor's knowledge of Base Facility conditions "as-found" and the requirements for the Work, propose graphic or written alternatives to Drawings and Specifications to correct discrepancies. Include as supplementary data to the Request for Information.
- D. Modifications due to concealed conditions are allowed only for conditions which are accessible only through cutting or demolition operations.
  - 1. No changes in the Contract Sum or Time are permitted for sight-exposed conditions or conditions visible by entry into access doors or panels and above lay-in or concealed spline acoustical ceilings, or by conditions described in Documents 00320 - Geotechnical Information or 00330 - Existing Conditions.

1.09 REQUEST FOR INFORMATION OR CLARIFICATION

- A. The Request for Information or Clarification does not authorize work that changes the Contract Price or Time.
- B. Request clarification of Contract Documents or other information by using the Request for Information or Clarification.

**MODIFICATION PROCEDURES**

**MODIFICATION PROCEDURES**

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1. If additional work is required, then the requirement will be requested by the City Engineer's issuance of a Request for Information or Clarification; Request for Proposal; Work Change Directive.
  2. This document does not authorize work to proceed.
- C. Changes may be proposed by the Contractor only by submitting a Request for Information following Paragraph 1.08.
- D. The City Engineer may issue minor changes in the Work, not involving an adjustment to Contract Price or Time using a Request for Information or Clarification and following Document 00700 - General Conditions.
- E. Follow directions on back of the Request for Information or Clarification.

1.10 CORRELATION OF SUBMITTALS

- A. For Stipulated Price Contracts, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Price, following Section 01290 - Payment Procedures.
- B. For Unit Price Contracts, revise the next monthly estimate of work after acceptance of a Change Order to include new items not previously included and the appropriate unit rates.
- C. Promptly revise progress schedules to reflect any change in Contract Time, revise schedules to adjust time for other items of work affected by the change and resubmit for review following Section 01325 - Construction Schedules.
- D. Promptly record changes on record documents following Section 01770 - Contract Closeout.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**MODIFICATION PROCEDURES**

**01255-5** ver. 10.07.18



**SECTION 01270**  
**MEASUREMENT AND PAYMENT**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Procedures for measurement and payment plus conditions for nonconformance assessment and nonpayment for rejected Products.

1.02 AUTHORITY

- A. Measurement methods delineated in Specification Sections are intended to complement criteria of this Section. In event of conflict, requirements of the Specification Section shall govern.
- B. Project Manager will take all measurements and compute quantities accordingly.
- C. Assist by providing necessary equipment, workers, and survey personnel
- D. Measurement and Payment paragraphs are included only in those Specification Sections of Division 01, where direct payment will be made. Include costs in the total bid price for those Specification Sections in Division 01 that do not contain Measurement and Payment paragraphs.

1.03 UNIT QUANTITIES SPECIFIED

- A. Quantity and measurement estimates stated in the Agreement are for contract purposes only. Quantities and measurements supplied or placed in the Work and verified by Project Manager will determine payment as stated in Article 9 of Document 00700 – General Conditions.
- B. When actual work requires greater or lesser quantities than those quantities indicated in Document 00410 – Bid Form, provide required quantities at Unit Prices contracted, except as otherwise stated in Article 9 of Document 00700 – General Conditions.

1.04 MEASUREMENT OF QUANTITIES

- A. Measurement by Weight: Reinforcing Steel, rolled or formed steel or other metal shapes are measured by CRSI or AISC Manual of Steel Construction weights. Welded assemblies are measured by CRSI or AISC Manual of Steel Construction or scale weights.
- B. Measurement by Volume:
  - 1. Stockpiles: Measured by cubic dimension using mean length, width, and height or thickness.

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- 2. Excavation and Embankment Materials: Measured by cubic dimension using average end area method.
  - C. Measurement by Area: Measured by square dimension using mean length and width or radius.
  - D. Linear Measurement: Measured by linear dimension, at item centerline or mean chord.
  - E. Stipulated Price Measurement: By unit designation in the Agreement.
  - F. Other: Items measured by weight, volume, area, or linear means or combination, as appropriate, as completed item or unit of the Work.
  - G. Measurement by Each: Measured by each instance or item provided.
  - H. Measurement by Lump Sum: Measure includes all associated work.

#### 1.05 PAYMENT

- A. Payment includes full compensation for all required supervision, labor, Products, tools, equipment, plant, transportation, services, and incidentals; and erection, application or installation of an item of the Work; and Contractor's overhead and profit.
- B. Total compensation for required Unit Price work shall be included in Unit Price bid in Document 00410 – Bid Form. Claims for payment as Unit Price work, but not specifically covered in the list of Unit Prices contained in Document 00410 – Bid Form, will not be accepted.
- C. Interim payments for stored materials will be made only for materials to be incorporated under items covered in Unit Prices, unless disallowed in Document 00800 - Supplementary Conditions.
- D. Progress payments will be based on Project Manager's observations and evaluations of quantities incorporated in the Work multiplied by Unit Price.
- E. Final payment for work governed by Unit Prices will be made on the basis of actual measurements and quantities determined by Project Manager multiplied by the Unit Price for work which is incorporated in or made necessary by the Work.

#### 1.06 NONCONFORMANCE ASSESSMENT

- A. Remove and replace work, or portions of the Work, not conforming to the Contract documents.
- B. When not practical to remove and replace work, City Engineer will direct one of the following remedies:
  - 1. Nonconforming work will remain as is, but Unit Price will be adjusted lower at discretion of City Engineer.

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- 2. Nonconforming work will be modified as authorized by City Engineer, and the Unit Price will be adjusted lower at the discretion of City Engineer, when modified work is deemed less suitable than specified
  - C. Specification sections may modify the above remedies or may identify a specific formula or percentage price reduction.
  - D. Authority of City Engineer to assess nonconforming work and identify payment adjustment is final.

1.07 NONPAYMENT FOR REJECTED PRODUCT

- A. Payment will not be made for any of the following:
  - 1. Products wasted or disposed of in an unacceptable manner.
  - 2. Products determined as nonconforming before or after placement.
  - 3. Products not completely unloaded from transporting vehicles.
  - 4. Products placed beyond lines and levels of required work.
  - 5. Products remaining on hand after completion of the Work, unless specified otherwise.
  - 6. Loading, hauling, and disposing of rejected Products.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01290**  
**PAYMENT PROCEDURES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Schedule of Values.
- B. Billing forecast.
- C. Value/ time log.
- D. Expenditure of Cash Allowances.
- E. Applications for Payment.
- F. Payment for mobilization work.
- G. Final payment.

1.02 DEFINITIONS

- A. *Schedule of Values*: Itemized list, prepared by the Contractor, establishing the value of each part of the Work for a Stipulated Price contract, or for Major Stipulated Price items for a Unit Price contract. The Schedule of Values is the basis for preparing applications for payment. Quantities and unit prices may be included in the schedule when approved or required by City Engineer.
- B. *Major Stipulated Price Item*: Item listed in Document 00410 - Bid Tabulation Form which qualifies as Major Unit Price Work following Document 00700 - General Conditions Paragraph 9.1.5.

1.03 SUBMITTALS

- A. The Contractor must utilize, a web-based system run by the Houston Airport System, to submit Invoices. Before doing so, the Contractor must attend a brief mandatory training session, which will be conducted by a member of HAS. The Contractor must contact the designated HAS trainer prior to the start of construction to schedule a time for training. Access to will not be given to the Contractor's team until training is completed. All document collaboration will be done using a web-based system.

**PAYMENT PROCEDURES**

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- B. Submit electronic version in native format of preliminary Schedule of Values at the Preconstruction Conference (Section 01312 - Coordination and Meetings). Submit electronic copy in native format of final and updated Schedule of Values with each copy of Application for Payment.
- C. Submit electronic version in native format of Billing Forecast and Value/Time Log at first Progress Meeting (Section 01312 - Coordination and Meetings). Obtain approval before making first application for payment. Coordinate this submittal with Master Schedule specified in Section 01325 - Construction Schedules.
- D. Produce electronic document for Billing Forecast and Value/Time Log on 8 1/2 by 11-inch white bond paper.

1.04 SCHEDULE OF VALUES

- A. Prepare Schedule of Values as follows:
  - 1. Prior to the submission of the initial Application for Payment, Contractor shall obtain Project Manager approval for the format and content of the schedule of values for all invoices including the grouping of costs along the lines of specific equipment, asset or deliverable produced as a result of the work performed.
  - 2. For Stipulated Price contracts, use the Table of Contents of the Project Manual as the outline for listing the value of work by Sections.
  - 3. For Unit Price contracts, use Document 00410 as the outline. Include a proportional share of Contractor's overhead and profit in each Unit Price item so the sum of all items equals the Contract Price.
  - 4. List mobilization, bonds, insurance, accepted Alternates and Cash Allowances as separate items.
- B. Round off values for each item to the nearest \$100.00, except for the value of one item of the Contractor's choice, if necessary, to make the total of all items in the Schedule of Values equal the Contract Price.
- C. At direction of City Engineer revise the Schedule of Values and resubmit for items affected by Modifications, at least 10 days prior to submitting the next Application for Payment. List each Change Order as a separate item.

1.05 BILLING FORECAST

Prepare an electronic graphic or tabular Billing Forecast of estimated monthly applications for payment for the Work.

- A. This information is not required in the monthly updates, unless significant changes in work require resubmittal of the schedule. Allocate the units indicated in the bid schedule

or the schedule of values to Construction Schedule activities (weighted allocations are acceptable, where appropriate). Spread the dollar value associated with each allocated unit across the duration of the activity on a monthly basis. Indicate the total for each month and cumulative total.

- B. Billing forecast is only for planning purposes of City Engineer. Monthly payments for actual work completed will be made by City Engineer following Document 00700 - General Conditions.

#### 1.06 VALUE/ TIME LOG

Prepare an electronic Value/ Time Log as a slope chart, showing:

- A. Original Contract Time/ Modified Contract Time: x coordinate, in weeks.
- B. Original Contract Value/ Modified Contract Value: y coordinate, in thousands of dollars.

#### 1.07 EXPENDITURE OF CASH ALLOWANCES

- A. Verify with City Engineer that work and payment requested is covered by Cash Allowance.
- B. Prepare electronic version of Document 00685 - Request for Information following Section 01726 - Base Facility Survey, include following minimum data to support Contractor's request for expenditure of Cash Allowances listed in Section 01210 - Cash Allowances, and process in a timely manner to allow detailed review by City Engineer:
  - 1. Statement of fact indicating reason(s) expenditure is required. Include photographs or video following Section 01321 - Construction Photographs documenting existing conditions.
  - 2. Quantity survey, made from on-site measurements, of quantity and type of work required to properly complete work.
  - 3. Cost of work, including detailed proposals from trade(s) responsible. For work governed by unit prices, applying unit prices following this Section.
  - 4. Trade(s) responsible for corrective work.
  - 5. Change in Contract Time.
  - 6. Administrative data, including contract name and number, and Contractor's name.
- C. Do not commence affected work without written authorization.
- D. Process approved expenditures following Section 01255 - Modification Procedures and Application for Payment process below.

1.08 APPLICATIONS FOR PAYMENT

- A. Submit each Application for Payment following Document 00700 and as directed via SharePoint which utilizes an electronic version of the American Institute of Architects Document G702 including G703 continuation sheets.

1.09 PAYMENT FOR MOBILIZATION WORK

- A. Measurement for mobilization is on a lump sum basis if included as a unit price in Document 00410.
- B. Mobilization payments paid upon application by Contractor subject to:
  - 1. Authorization for payment of 50 percent of the contract price for mobilization will be made upon receipt and approval by City Engineer of the following submittal items, as applicable:
    - a. Schedule of values.
    - b. Trench safety program.
    - c. Construction schedule.
    - d. Photographs.
    - e. Submit QC Program
- C. Authorization for payment of the remaining 50 percent of the Contract Price for mobilization will be made upon completion of Work amounting to 5 percent of the Contract Price less the mobilization unit price.
- D. Mobilization payments are subject to retainage amounts stipulated in the Document 00700.

1.10 FINAL PAYMENT

- A. When Contractor considers the Work is complete, submit written certification that:
  - 1. Work is fully inspected by the Contractor for compliance with Contract Documents.
  - 2. Work follows the Contract Documents, and deficiencies noted on the Punch List are corrected.
  - 3. Products are tested, demonstrated and operational.
  - 4. Work is complete and ready for final inspection.

- B. In addition to submittals required by Document 00700 and other Sections:
1. Furnish submittals required by governing authorities, such as Certificate of Occupancy and Certificates of Inspection.
  2. Submit a final statement of accounting giving total adjusted Contract Price, previous payments, and sum remaining due (final Application for Payment).
- C. When the Work is accepted, and final submittals are complete, a final Certificate for Payment will be issued.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION



**SECTION 01292**  
**SCHEDULE OF VALUES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preparation and submittal of Schedule of Values for Stipulated Price Contracts or for Major Unit Price Work on Unit Price Contracts.

2.01 PREPARATION

- A. For Stipulated Price Contracts, subdivide the Schedule of Values into logical portions of the Work, such as major work items or work in contiguous construction areas. Use Section 01325 Construction Schedules as a guide to subdivision of work items. Directly correlate Items in the Schedule of Values with tasks in the Construction Schedule. Organize each portion using the Project Manual Table of Contents as an outline for listing value of the Work by Sections. A pro rata share of mobilization, Bonds, and insurance may be listed as separate items for each portion of the Work.

- B. For Unit Price Contracts, items should include a proportional share of Contractor's overhead and profit so that total of all items will equal Contract Price.

- C. For lump sum equipment items, where submittal of operation and maintenance data and testing are required, include separate items for equipment operation and maintenance data where:

- 1. submittal of maintenance data is valued at five percent of the lump sum amount for each equipment item and

- 2. submittal for testing and adjusting is valued at five percent of the lump sum amount for each equipment item.

Round off figures for each item listed to the nearest \$100. Set the value of one item, when necessary, to make total of all values equal the Contract Price for Stipulated Price Contracts or the lump sum amount for Unit Price Work.

3.01 SUBMITTAL

- A. Submit the Schedule of Values, in accordance with requirements of Section 01330 - Submittal Procedures, at least 10 days prior to processing of the first Certificate for Payment.

- B Submit the Schedule of Values in an approved electronic spreadsheet file and an 8 1/2•inch by 11•inch print on white bond paper.
- C. Revise Schedule of Values for items affected by Contract Modifications. After City Engineer has reviewed changes, resubmit at least 10 days prior to the next scheduled Certificate for Payment date.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

**SECTION 01312**  
**COORDINATION AND MEETINGS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. General coordination is required throughout the documents and the Work. Refer to all of the Contract Documents and coordinate as required to maintain communications between Contractor, City and Designer; Subcontractors and Suppliers. Assist City with communications between Contractor and City's separate contractors.
- B. Preconstruction conference.
- C. Progress meetings.
- C. Daily briefings.

**1.02 SUBMITTALS**

In addition to submittals related to meetings and described elsewhere in this Section, see following Sections for submittals prepared under those Sections, but submitted under this Section:

- A. Section 01255 - Modification Procedures: Individual authorized to execute Modifications.
- B. Section 01506 - Temporary Controls: "Airport Construction Control Plans", containing submittals prepared under Section 01506 and other Sections referenced therein.

**1.03 RESPONSIBILITIES FOR MEETINGS**

- A. City Engineer may act directly or through designated representatives identified by name at the Preconstruction Conference, and will schedule, chair, prepare agenda, record and distribute minutes and provide facilities for conferences and meetings.
- B. Contractor:
  - 1. Present status information and submittal data for applicable items.
  - 2. Record and distribute Contractor's corrections to meeting minutes.
  - 3. Provide submittal data for attendees. Prepare, reproduce and issue Contractor's documents to support conferences and meetings. Issue typically as part of each session unless more frequent publication is necessary. Issue one copy to each conference attendee, and to others as directed by City Engineer and as required by Contractor.

**COORDINATION AND MEETINGS**

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- a. Transmit documents requiring urgent action by email or messenger.
  - b. Provide electronic and/or hard copies as required to properly document the project or project actions. The Contractor shall coordinate the submittal format with the City Engineer.
  - c. Initiate and provide facilities for Coordination Meetings as required in 1.04. H.1.
  - d. Costs for documentation are the Contractor's responsibility.
- 1.04 CONTRACTOR COORDINATION
- A. Coordinate scheduling, submittals, and work of Sections to achieve efficient and orderly sequence of installation of interdependent construction elements.
  - B. Verify characteristics of products are compatible with existing or planned construction. Coordinate work of various Sections having interdependent responsibilities for installing, connecting to, and placing products in service.
  - C. Coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
  - D. Conceal pipes, ducts, wiring and fasteners in finished areas, except as otherwise indicated. Coordinate locations of fixtures and outlets with finish elements. Locate work requiring accessibility to coordinate with existing access panels and doors.
  - E. Coordinate completion and clean up of work for Substantial Completion and for portions of the Work designated for partial occupancy.
  - F. Coordinate access to site and within the work area(s) for correction of nonconforming work. Minimize disruption of occupants' activities where work areas are occupied.
  - G. Do not proceed with affected work until discrepancies in contract requirements are resolved and unsatisfactory substrate and site conditions are corrected.
  - H. Coordination Drawings: Before materials are fabricated or Work begun, prepare coordination Drawings including plans, elevations, sections, and other details as required to clearly define relationships between sleeves, piping, ductwork, conduit, ceiling grid, lighting, fire sprinkler, HVAC equipment and other mechanical, plumbing and electrical equipment with other components of the building such as beams, columns, ceilings, and walls.
    1. Hold Coordination Meetings with trades providing the above Work, to coordinate Work of the trades for each floor and mechanical areas.
    2. Prepare coordination Drawings to 1/4" = 1'-0" scale for general layout and 3/8" = 1'-0" for plans and sections in congested areas such as equipment spaces.

**COORDINATION AND MEETINGS**

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3. Resolve conflicts between trades, prepare composite coordination Drawings and obtain signatures on original composite coordination Drawings.
4. When conflicts cannot be resolved, Contractor shall request clarification prior to proceeding with that portion of the Work affected by such conflicts or discrepancies. Prepare interference Drawings to scale and include plans, elevations, sections, and other details as required to clearly define the conflict between the various systems and other components of the building such as beams, columns, and walls, and to indicate the Contractor's proposed solution.
5. Submit Drawings for approval whenever job measurements and an analysis of the Drawings and Specifications by the Contractor indicate that the various systems cannot be installed without significant deviation from the intent of the Contract. When such an interference is encountered, cease Work in the general areas of the conflict until a solution to the question has been approved by the project Architect/Engineer.
6. Submit original composite coordination Drawings as part of record document submittals specified in Section 01770.

1.05 PRECONSTRUCTION CONFERENCE

- A. Attendance Required: City Engineer's representatives, Construction Manager (when so employed), Designer(s), Contractor, Contractor's Superintendent, and major Subcontractors.
- B. Submittals for review and discussion at this conference:
  1. Draft Schedule of Values, following Section 01290 - Payment Procedures.
  2. Bound draft of Airport Construction Plans, following Sections 01506 - Temporary Controls and 01555 - Traffic Control and Regulation.
  3. Draft construction schedule(s), following Section 01325 - Construction Schedules.
  4. Draft Submittal Schedule, following Sections 01325 - Construction Schedules and 01340 - Shop Drawings, Product Data and Samples.
- C. Agenda:
  1. Status of governing agency permits.
  2. Procedures and processing of:
    - a. Submittals (Section 01340 - Shop Drawings, Product Data and Samples).
    - b. Permitted substitutions (Section 01630 - Product Options and Substitutions).
    - c. Applications for payment (Section 01290 - Payment Procedures).
    - d. Document 00685- Request for Information.

**COORDINATION AND MEETINGS**

- e. Modifications Procedures (Section 01255 - Modification Procedures).
- f. Contract closeout (Section 01770 - Contract Closeout).
- 3. Scheduling of the Work and coordination with other contractors (Sections 01325 - Construction Schedules, 01326 - Construction Sequencing and this Section).
- 4. Agenda items for Site Mobilization Conference, if any, and Progress Meetings.
- 5. Procedures for Daily Briefings, when applicable.
- 6. Procedures for City's acceptance testing [(Section 01455) and Contractor's testing [(Section 01450 - Contractor's Quality Control).
- 7. Record documents procedures (Section 01770 - Contract Closeout).
- 8. Finalization of Contractor's field office and storage locations (Section 01505 - Temporary Facilities).
- 9. Use of premises by City and Contractor (Section 01145 - Use of Premises).
- 10. Status of surveys (01726 - Base Facility Survey).
- 11. Review of temporary controls and traffic control (Sections 01506 - Temporary Controls and 01555 - Traffic Control and Regulation).
- 12. Construction controls provided by City.
- 13. Temporary utilities and environmental systems (Section 01505 - Temporary Facilities).
- 14. Housekeeping procedures (Section 01505 - Temporary Facilities).

1.06 PROGRESS MEETINGS

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**Edit location of Progress Meetings.**

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- A. City Engineer will hold Progress Meetings weekly, or at other frequency determined by progress of the Work, at Department of Aviation office at  
  
[111 Standifer Street (at George Bush Intercontinental Airport/ Houston), Houston, Texas 77338 (281) 233-3000.]  
  
[8800 Paul Koonce (at William P. Hobby Airport), Houston, Texas 77061 (713) 643-0632.]
- B. Attendance Required: Contractor's Superintendent, major Subcontractors' and Suppliers' superintendents, City Engineer representatives, and Designer(s), as appropriate to agenda topics for each meeting.

**COORDINATION AND MEETINGS**

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- C. Submittals for review and discussion at this conference:
1. Project schedule (Section 01325 - Construction Schedules).
  2. Submittal Log (Section 01340 - Shop Drawings, Product Data and Samples).
  3. Log of Document 00685 - Request for Information.
- D. Agenda:
1. Review minutes of previous meetings to note corrections and to conclude unfinished topics.
  2. Review of: progress schedule; coordination issues if any; corrective measures if any to regain planned progress; planned progress during succeeding work period; off-site fabrication and product delivery schedules.
  3. Field observations, problems, and decisions.
  4. Identification of problems which impede planned progress and Contractor's proposals for resolution.
  5. Review of submittals schedule and status of submittals.
  6. Review of RFI status.
  7. Review of Request for Proposal, Work Change Directive and Change Order status.
  8. Closings and impediments (Section 01145 - Contractor's Use of Premises).
  9. Maintenance of quality and work standards (Sections 01450 - Contractor's Quality Control and 01455 - City's Acceptance Testing).
  10. Effect of proposed changes on progress schedule and coordination.
  11. Other items affecting completion of the Work within contracted cost and time.

1.07 DAILY BRIEFINGS

- A. In addition to Progress Meetings, hold briefings as frequently as required, at place designated by the City Engineer, to coordinate details of construction and airport operations. Discuss specific requirements, procedures and schedule changes, and closures and impediments.
- B. When required, hold briefing before start of work each day, to confirm that required activities are properly allocated and unchanged.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION



**SECTION 01321  
CONSTRUCTION PHOTOGRAPHS**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Progress photographs to supplement Applications for Payment.
- B. Detail photographs and video to supplement Request for Information.

**1.02 MEASUREMENT AND PAYMENT**

- A. Cost of photographs is incidental to the Contract Price. No additional costs will be paid for other than administrative costs of extra copies and photographs resulting from additional station points.
- B. Following work will be paid on a Unit Price basis:
  - 1. Extra Prints: Per print.
    - a. Extra prints provided direct from the photographer to parties authorized by the City Engineer up to date of Substantial Completion, priced at prevailing local commercial rates. Include photographer's costs and Contractor's administrative costs only.
    - b. Extra prints provided direct from the photographer to the City Engineer up to 3 years after the date of Substantial Completion, priced at prevailing local commercial rates. Include photographer's costs but not Contractor's costs for this service.
  - 2. Additional Station Points: Per stationpoint, for photographs made during same trips as Paragraph 2.01.
- C. Emergencies: Per trip to site. Take additional photographs or video, as appropriate to conditions, within 24 hours of the City Engineer's request. This applies to professional photography required by conditions stated in Paragraph 8.2.1 in Document 00700 - General Conditions.
- D. Following photography will be commissioned by Modification: Publicity photographs; special events at site; photographs taken at fabrication locations off-site.

**1.03 SUBMITTALS**

- A. Station point Plan: One copy of the Site Plan, marked to show plan, altitude and cone-of-view of each stationpoint selected by the City Engineer or Designer. Submit at least 10 days prior to taking Preconstruction Photographs.

**CONSTRUCTION PHOTOGRAPHS**

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- B. Preconstruction Photographs: Same as Paragraph B., except one-time only, and marked as such.
- C. Progress Photographs: 3 prints (or digital copies) on approved media of each view. Submit 2 prints and 1 color aerial photograph of the project site (or digital copies) with each Application for Payment. Retain 1 print (or digital copy) by the Contractor at the work site and available at all times for reference. Retain photographic digital files, at the photographer's office, for 3 years after Substantial Completion.
- D. Photographs and Video Supporting RFI: Identify following with RFI number and date of photographs:
  - 1. Submit 1 copy of 3x5 inch prints on white card stock in clear plastic sleeves.
  - 2. Submit video on CD's or other approved media. Include video identification number, date of record, approximate location, and brief description of record.
- E. Contract Closeout: Follow Section 01770, Contract Closeout to:
  - 1. Return electronic copies of RFI photographs and video on CD's or other approved media device, identified by Project name, Contractor, and date photographs were taken.
  - 2. Return video on CD's or other approved media device, identified with contents, by RFI number, and each CD or other approved media device numbered sequentially and with "Date From/ To" on each.
- F. Aerial Progress Photographs: Submit 5 prints and 1 CD of 2 consistent oblique views with each Application for Payment. Retain 1 print by the contractor at the work site and available at all times for reference. The photos shall be large format oblique angles taken from a height and viewpoint to be selected by the City Engineer.

1.04 QUALITY ASSURANCE

- A. Timely take and produce photographs from proper station points and provide proper image quality.
- B. Cooperate with the photographer's work. Provide reasonable auxiliary services as requested, including access and use of temporary facilities including temporary lighting.
- C. Qualifications of Photographer for General Progress Photographs: A firm or individual of established reputation regularly engaged as a professional building or scene photographer for not less than 3 years.
- D. Qualifications of Photographer for RFI Photographs and Video: An employee of the Contractor knowledgeable in photography and videotaping technique, including proper use of video pan-zoom, close-ups, lighting, audio control, clear narrative, smooth transition between subjects, and steady camera support.

**CONSTRUCTION PHOTOGRAPHS**

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- E. Qualifications of Aerial Photographer: A firm or individual of established reputation, regularly engaged in aerial photography with prior experience at IAH.

**PART 2 PRODUCTS**

**2.01 MEDIA**

- A. Fixed-Film: 35mm color print film or color slide film, as determined by City Engineer; ASA 100 minimum, higher when required by lighting conditions.
- B. Paper Prints:
  - 1. For Progress Photographs: 8x10 inch matte-finish color, in clear plastic envelop with reinforced 3-ring binding.
  - 2. For RFI Photographs: 3x5 inch minimum size, matte-finish color, contact-mounted on flexible white paper card stock in clear plastic envelop with reinforced 3-ring binding.
- C. Video: Approved playable PC digital format; record at slowest speed or speed capable of freezing a clear image on "Pause"; date and time stamp as part of recording process. Use audio function for slate data below.
  - 1. Provide color playback equipment at Contractor's site office, with minimum 13-inch (diagonal) screen size.
- D. Bitmapped (Digital) Images: TIFF, JPG, PNG, GIF, JPEG, BMP, TGA, or TIFF format, maximum 1280x480 and minimum 480x480 pixels, digitally date and time stamped.

**2.02 PRECONSTRUCTION, PROGRESS AND RFI PHOTOGRAPHS**

- A. Preconstruction Photographs: Prior to beginning on-site construction, take five sets of fixed-film photographs of the project area from approved stationpoints. Show condition of existing site area, and particular features as directed, within contract limits.
  - 1. At exterior views, surrounding situs, showing streets, curbs, esplanades, landscaping, runway, taxiway and apron pavement.
  - 2. At interior views, surrounding situs, showing floors, walls, ceilings and architectural signs.
  - 3. Take pan-view photographs as required to encompass existing conditions.
- B. Progress Photographs for Applications for Payment: Take 3 fixed-film photographs from each of 2 station-points (same station points each time to show a time-lapse sequence), coinciding with the cutoff date associated with each application for payment, and at Substantial Completion of each stage of the Work.

**CONSTRUCTION PHOTOGRAPHS**

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- C. Photographs and Video for Request for Information: Take photographs and video as required to support Document 00685, Request for Information:
1. Details of existing conditions before construction begins.
  2. Details of construction.
  3. Details of damage or deficiencies in existing construction and work of separate contractors.
  4. Take number of images as required to fully show conditions.

PART 3 EXECUTION

3.01 GENERAL

- A. Do not record over previous video records.
- B. Provide clear, sharp, vibration-less video data and clear audio without detrimental background noise.

END OF SECTION

**SECTION 01325**  
**CONSTRUCTION SCHEDULES**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.
- B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.
- C. City of Houston (City) Policies, Standards and Procedures, as applicable.

2.01 SECTION INCLUDES

- A. Project Schedules and Progress Reporting
- B. Construction Sequencing and Phasing

3.01 DEFINITIONS

- A. Contractor: With respect to the Division 01 requirements, the entity contracted by the City to deliver the preconstruction and construction services defined in the Contract Documents.
- B. Design Consultant - Person or firm and its authorized representatives, under contract with the City, to provide professional services during pre-construction and construction.
- C. Project Scheduling Techniques
  - 1. CPM: Critical Path Method
  - 2. PDM: Precedence Diagramming Method
- D. Section Definitions
  - 1. **Activity:** A discrete element of Work or task performed during the course of the Project. Each schedule activity shall be clearly defined depicting duration, start and finish dates, logic links to predecessor and successor activities and supported by defined resources where applicable. The activities shall be detailed in such a way, that they shall support the planning and measurement of physical percent complete

- for the purposes of Earned Value Management reporting.
2. **Baseline Schedule:** The schedule prepared by the Contractor and approved by the City which is the basis for representing the full scope of Work, the time scales and phasing for delivery, providing a means against which progress can be determined.
  3. **Commissioning and Integration Testing Schedule:** Activities contained within the Project Schedule depicting startup, testing and commissioning phase of the Project, including activities associated with the transition to revenue service and required for achievement of Final Acceptance.
  4. **Constraint:** Scheduling restriction imposed on start or finish of an activity. A constraint restricts the movement of an activity based on the type of constraint and the date used and may override the logic relationship also assigned to the activity.
  5. **Construction Schedule:** Activities within the Project Schedule which depicts the construction activities performed or to be performed by the Contractor as a part of the Project.
  6. **Contractor's Project Management Plan:** A formal document prepared by the Contractor and approved by the City which describes how the Project will be planned and progressed and delivered by the Contractor and the necessary reviews and acceptances by the City.
  7. **Cost Breakdown Structure:** The breakdown structure the Contractor shall use to distribute contract costs in the various estimates, Schedule of Values and in alignment to the Work Breakdown Structure.
  8. **Critical Path Method (CPM):** Scheduling technique utilizing activities, durations, and interrelationships/dependencies (logic), such that activities are interrelated with logic ties from the beginning of Project to Final Acceptance.
  9. **Data Date:** Date when the status of schedule activities is determined for a Monthly Progress Schedule report. Any data prior to the Data Date is considered historical information and data after is the forecast of remaining work.
  10. **Design Schedule:** Activities within the Project Schedule which includes the design activities of the Project. The Design Schedule shall demonstrate the interdependence between design activities and the Owner's requirements. The Design Schedule shall also demonstrate the relationships between design activities and the requirements to successfully deliver the activities within the Construction Schedule.
  11. **Float:** The term "float" shall refer to "end float", also called "terminal float" End or terminal float is the period by which the finish of the longest path through a schedule (the critical path) can be delayed, brought forward, or extended without affecting the

- completion date.
12. **Float Suppression:** Any technique that causes an activity to show less float, including but not limited to, as late as possible constraints and unnecessary lags.
  13. **Fragnet:** A group of interrelated activities taken from or to be added to a Schedule that can stand on their own representing only a portion of a CPM schedule. For example, a Fragnet can be used to portray a scope of work being added to, or changed from, a Project Schedule.
  14. **Key Plans:** Graphic representations on prints of Contract Documents of Contractor's planned breakdown of Project for scheduling purposes. Key plans shall clearly define boundaries of work for each designated segment, locations, and sub-locations. Alphanumeric codes on plans shall match code values for activity code designation in the Project Schedule.
  15. **Lag:** Time that an activity follows or is offset from the start or finish of its predecessor.
  16. **Materials Plan:** A plan for purchase, fabrication, delivery, storage and issuing of materials and products to the Project which must be integrated into the Project Schedule.
  17. **Look-Ahead Schedule:** An element schedule prepared by the Contractor detailing the status of the work as of the Progress Date and Contractor's plan for executing the remaining work before recalculation and/or re-sequencing.
  18. **Longest Path:** The Longest Path is the Path through a Project network from start to finish where the total duration is longer than any other path. The Longest Path is determined by the string of activities, relationships that push the Project to its latest early finish dates.
  19. **Monthly Progress Schedules:** The updates to the Project Schedules prepared by Contractor and submitted to the City on a monthly basis with the Application for Payment. There are two versions of Monthly Progress Schedules submitted; a Progress Only (PO) version and a Contractor Adjusted (CA) version.
  20. **Preconstruction Schedule:** An element of the Project Schedule prepared by the Contractor which includes activities prior to approval to proceed with construction activities.
  21. **Project Schedule:** A CPM Schedule prepared by the Contractor that includes all elements of the Scope of Work of the Contract. The Project Schedule clearly identifies all relationships that exist within the Scope of Work. The Project Schedule communicates the sequencing of the multiple phases of work. The Project Schedule

- identifies interfaces, both internal and external to the Scope of Work of the Contract. The Project Schedule encompasses the Baseline Schedule, Look Ahead Schedules, Delivery Phase Schedules (Design, Procurement, Detailing, Fabrication, Shipment, Installation, Construction, Startup, Testing and Commissioning), updated or revised Baseline Schedules. The Project Schedule also includes Monthly Progress Schedules, Proposed Schedules, Schedule Fragnets, Recovery Schedules.
22. **Program Schedule:** When multiple Projects are logically linked into a Program, the Program Schedule is prepared by the City and incorporates all the interrelated projects by combining the individual Project Schedules. Project Schedules become element schedules of the Program Schedule.
  23. **Proposed or Preliminary Schedule:** A schedule prepared by Contractor, prior to approval of the schedule by the City and subsequent incorporation into the Project Schedule. Also referred to as Draft or Initial Schedule.
  24. **Recovery Schedule:** A schedule prepared by the Contractor and to be approved by the City which details the Contractor's plan for recovery of time lost on the Project and associated costs.
  25. **Revised Baseline Schedule:** A revision to the Baseline Schedule that is necessitated to accurately reflect a significant change in scope or phasing of the scheduled Activities. The Baseline Schedule shall not be revised without prior approval by the City.
  26. **Status Data Date:** The "as-of" date up to which all progress has been updated and reflected in the Status report. The Status Data Date is also the date from which a Look-ahead Schedule predicts future activities and progress.
  27. **Submittal Schedule:** A register (list) of the Submittals to be made for materials, products, shop drawings, plans which is prepared by the Contractor and includes durations needed for submittal, reviews and processing. The dates and durations are to be coordinated with the associated activities within the Project Schedule.
  28. **Delay Analysis:** Technique that demonstrates comparison of time impact for each schedule revision or proposed revision against the current Project Schedule. Methodology shall follow Association for the Advancement of Cost Engineering International (AACEI) Delay Analysis as applied in Construction (Recommended Practice No. 52R-06.) as a guideline or method submitted by the Contractor and approved by the PMT.
  29. **Work Breakdown Structure (WBS):** A deliverable-oriented breakdown of a project into decreasingly smaller components, also described as a hierarchical decomposition of the project team's work into manageable sections.
  30. **Working Day:** Day scheduled for active execution of Work in the Project Schedule



Calendar in accordance with the Contract and as approved by the City.

#### 4.01 SUMMARY

##### A. Acceptance of Schedule Requirements by Contractor

1. The Contractor accepts the responsibility to complete the project on time as called for in the contract.

##### B. Schedule Requirements

1. The Contractor is responsible for determining the sequence of activities, the time estimates for the detailed construction activities and the means, methods, techniques and procedures to be employed. The Project Schedule shall represent the Contractor's plan of how it will prosecute the Work in compliance with the Contract requirements. Contractor shall ensure that the Project Schedule is current and accurate and is properly and timely monitored, updated and revised as Project conditions may require and as required by the Contract Documents. Unless the context indicates otherwise, the term "schedule" used herein will be read to include updated schedules.
2. Schedules shall contain logic and necessary components to perform Critical Path Method (CPM) network analysis. Contractor's schedule shall also be able to illustrate Precedence Diagramming Method (PDM).
3. Contractor shall include in the Project schedule contractual milestones and all interface points with City, Design Consultant(s), Subcontractors, Suppliers, and other Contractors. These points shall be in the form of Start Milestones for deliverables due to the Contractor from others, and as Finish Milestones for deliverables that Contractor must supply to City, Design Consultant(s), Subcontractors, Suppliers and other Contractors. Finish milestones must be determinate by predecessor activity, not by constrain.
4. Schedule shall contain activities for preparation and approval of contractor's design and submittal deliverables. Procurement, fabrication and delivery of mayor materials and long lead items. Obtain permits and construction activities.
5. Contractor shall allocate duration uncertainty to the scheduled activities within the contract schedule to enable a Quantitative Schedule Risk Analysis (QSRA) to be performed by the Program Management Team. Duration uncertainty (minimum duration, maximum duration, most likely duration) according to the relevant risk exposure shall be captured by the contractor against the scheduled activities. The PMT must rely on the data being supplied by the Contractor and incorporated and updated in line with the monthly schedule update process.
6. Contractor shall utilize the most current version of Primavera P6 (15.1 or Later) for

all schedules governed by these provisions.

7. The Contractor is responsible for assigning appropriate material, equipment and labor resource loading of the key quantities necessary to execute the activity. This will demonstrate realistic productivity rates as well as measure and report Key Performance Indicators (KPIs).
8. The City Engineer reserves the right to reject any schedule or report that fails to realistically or satisfactorily reflect completion of the Project scope of work or any agreed intermediate milestone. Failure of the Contractor to deliver satisfactory schedules or reports as required in the Contract Documents may result in actions by the City General Conditions.
9. The schedule shall show all activities in Work Days, with allowance for holidays or other periods when work is not permitted to be performed.
10. Detailed schedule requirements shall be contained within the City Policies, Standards and Procedures).
11. Contractor shall prepare schedules which assure that all work sequences are logical, and the network shows a coordinated plan for complete performance of the Work. Failure of the Contractor to include any element of work required for performance of the Contract in the network shall not excuse the Contractor from completing all Work within the Contract Time.
12. Contractor must have an approved workhour plan as noted in the approved Work Authorization Notification (WAN) prior to commencing work on the project site. Changes to the approved work-hours plan shall require 48-hour written notice and subsequent written approval by the City.

#### 5.01 SUBMITTAL REQUIREMENTS

The Contractor must utilize the City's web-based application management system for submittals. The Project Manager will coordinate training and access to the web-based application management system. The submittal processes are further defined in Section 01330 Submittal Procedures and in the City Policies, Standards and Procedures, as applicable.

- A. In addition to the PDF versions of the schedule required in this Section, submit one electronic copy of schedule in Primavera compressed format (.XER). Filename shall have a unique identifier and shall include a sequential number for each monthly update. PDF prints and reports shall be generated from same version of the Schedule that is provided in electronic form.
- B. Submittal of Contractor Schedules
  1. Submit Preconstruction Schedule for approval within 30 days of NTP for

#### Preconstruction Services

2. Submit the initial proposed Project Schedule for approval as a Baseline Schedule within 30 days of NTP for Construction Services.
3. Submit Monthly Progress Schedule and Narrative no later than 12:00 noon (local time) on the Wednesday before the last Friday of the month. The Data Date for the Monthly Progress is 00:00 hours on the Saturday following the last Friday of the Month. The Monthly Progress Schedule is required for each Application for Payment. Contractor may request to meet with the City prior to the submittal of the Monthly Progress Schedule and Application for Payment to resolve issues prior to submittal.
4. The weekly 3 weeks Look-Ahead Schedule shall be submitted every Tuesday at 08:00 hours with the previous week's progress updated. The Status Date of the Look-Ahead Schedule shall be the previous Saturday at 00:00 hours, progressed weekly.
5. Submit Delay Analysis per the ACEI recommended practice 52R-06 as follows:
  - a. Within ten work days after receipt of written change modification.
  - b. Within ten work days after receipt of written notice by City.
  - c. Within ten work days from beginning of delay caused by unforeseeable circumstances.
6. Submit Recovery Schedule following the event of a forecast delay. Contractor shall submit a Recovery Schedule within the 21 calendar days of Contractor receiving City's written request that is resource and cost justified indicating how the Contractor will recoup the impacted contract time.
7. Submit an As-Built Schedule within 30 work days after the City's Final Acceptance of the Work.
8. Submit a Submittal Log as a supplement documents for Monthly Progress Schedule, showing all submittals for products, materials, plans, and shop drawings, RFI's and administrative submittals required per the Technical Specifications including associated Specification Section numbers and headings.
  - a. Include durations and dates for processing by Reviewers and/or other parties as required. Indicate submittals requiring special processing such as short-duration reviews.
  - b. The Contractor shall coordinate packaging of individual submittals in a logical and organized fashion so that they may be reviewed in part or in whole with related elements of work with the Reviewers.

- c. Include durations and dates based on frequency of Contractor's submittals to City for items such as of administrative submittals such as Applications for Payment, Labor Reports, Safety Reports, MWBE Reports.

## 6.01 SCHEDULE CONTROL PROCEDURES AND QUALITY ASSURANCE

### A. Control Procedures

1. Procedures for schedule control shall be included in the Contractor's Project Management Plan as part of the plan implementation and reporting requirements. Prior to submission of Monthly Progress Schedule contractor should call for scheduling workshop with Houston Airports to propose schedule changes to remove out of sequence logic and to present accurate critical path. Allowed changes are only for removing or adding logic links. Changes in original durations, resources etc. are not permitted. After approval of schedule changes contractor can proceed with Monthly Progress Schedule submission. All changes must be recorded in schedule change control log and submitted as supplementary document in Monthly progress report.
2. If any in-progress activity is delayed for any reason, that activity will be split to track the reason for the delay. A separate activity for the delay will be created and placed in between the split.
3. Procedures for preparing and monitoring the Project Schedule and other required reporting.,
4. Procedures for performing quality oversight of the schedule review/forecast.
5. Earned Valued Methodology Procedures shall be implemented for performance measurement using data from the schedule to provide an effective means of comparing Work scheduled/planned versus Work performed. Please see Section 0 Section 01 32 16, 1.3.D1.Provide, as a minimum, a continuous review of actual progress against the most recent Project Schedule. This is to assure that revised resource allocation and/or other corrective action can be considered and undertaken proactively and as early as possible.

### B. Qualifications of Contractor's Scheduler

1. Contractor shall have within its employ or under separate Contract, throughout the execution of the Work under this Contract, such expertise in CPM scheduling and P6 software so as to insure its effective and efficient performance under this Specification. It shall be the responsibility of the Contractor to prepare input information for the Contract Schedule, monitor progress, provide input for updating and revising logic diagrams when necessary and otherwise fulfilling its obligations

hereunder. Contractor shall submit the qualifications of the CPM Specialist for acceptance by the City.

## 7.01 SCHEDULING PRINCIPLES AND REQUIREMENTS

### A. General

1. Contractor shall prepare the Schedules identified in this Section during the performance of Contract. The Schedules shall:
  - a. Be detailed, time-scaled, computer-generated schedules, using the Critical Path Method, that accurately depict activities representing each portion of the Work from the current Data Date through Final Acceptance.
  - b. Be used for planning and coordinating the Work.
  - c. Be the basis for reporting all the Work to be performed in fulfillment of the Contract Documents.
  - d. Accurately depict the Contractor's current logical activity sequences and activity durations necessary to complete the Work in accordance with the requirements of the Contract Documents.
  - e. Assist Contractor and City in preparation and evaluation of Contractor's monthly progress payments.
  - f. Assist the City in evaluating progress (including payment) of the Work.
  - g. Assist Contractor and City in monitoring progress of Work and evaluating proposed changes to the Contract and requests for additional contract time.
  - h. Provide for optimum coordination by Contractor of its trades, Subcontractors, and Suppliers, and of its Work with the Work or services provided by any separate Contractors.
  - i. Permit the timely prediction or detection of events or occurrences which may affect the timely prosecution of the Work.
  - j. Provide a mechanism or tool for use by the City, and Contractor in determining and monitoring any actions of the Contractor which may be required in order to comply with the requirements of the Contract Documents relating to the completion of the various portions of the Work by the Contract Time specified in the Contract Documents.
2. Contractor shall include in the Contract schedule all interface points with City, Design Consultant(s), Subcontractors, Suppliers, and other Contractors. These points shall be

in the form of Start Milestones for deliverables due to the Contractor from others, and as Finish Milestones for deliverables which Contractor must supply to City, Design Consultant(s), Subcontractors, Suppliers and other Contractors. The PMT will assist in obtaining the relevant data from other parties when required.

3. Contractor shall provide to the City duration uncertainty and risk events for scheduled activities within the contract schedule to enable a Quantitative Schedule Risk Analysis (QSRA) to be performed by the City. Duration uncertainty (minimum duration, maximum duration, most likely duration) according to the relevant risk exposure shall be captured by the contractor against the scheduled activities.
4. Calendar
  - a. Anticipated work and non-work periods shall be included for each activity.
  - b. Agreed Holidays shall be included as non-work days assigned to the appropriate day as they occur.
  - c. Anticipated Weather Lost Days
  - d. As the basis for establishing a “Weather Calendar”, use the National Oceanic and Atmosphere Administration’s (NOAA) historical monthly averages for days with precipitation, using a nominal 30- year, greater than 2.5 mm 0.10-inch amount parameter, as indicated on the Station Report for the NOAA location closest to the project site. In addition, incorporate into the Weather Calendar, other non-workdays such as Saturdays, Sundays and Federal Holidays.

**B. Activities**

1. Contractor shall use and/or implement generally accepted recommended industry practices and the City Policies, Standards and Procedures, as applicable.
2. Schedule activities shall be sufficiently named or titled to include what is to be accomplished and identified by the applicable work areas. Activities shall be grouped to assist in the understanding of the activity sequence. Examples of the types of activities to include in each schedule are as follows:
  - a. Design Activities: If and when Contractor has responsibility for the design as a part of the Contract, design activities shall be logically tied to the Construction Activities without constraints and Contractor shall develop an agreed design progress and performance measurement system based on design package deliverables and division of responsibilities. At a minimum, design work shall be divided to have an agreed number of deliverables per area/facility/system/subsystems and the governing jurisdictions. Actual design packaging scheme shall be agreed upon with the City prior to implementation.

**CONSTRUCTION SCHEDULES**

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When Contractor does not have responsibility for design as a part of the Contract the design activities shall be logically tied to the Construction Activities as start Milestones. Include Contractor's agreed design packaging scheme to support timely procurement of material, obtaining permits, and construction plan and include:

- 1) Agency review and approval cycles based on applicable Governmental Persons, Authority(s) Having Jurisdiction (AHJ) and other applicable Laws, Regulations, and Ordinances.
  - 2) Activities for each design phase (Concept, Schematic (30%), Design Development (60%) and Issued for Permit and Issued for Construction (100%) documents.
  - 3) Application for, and receipt, of required permits.
  - 4) Contractor's submittal of design and construction documents for City review and approval.
  - 5) Design review cycles and logical ties to subsequent fabrication, delivery, and construction activities.
  - 6) Other design related deliverables.
- b. Procurement Activities: Contractor's procurement activities included in schedules shall be logically tied with no constraints and shall be resource and cost loaded. Examples of Procurement activities include, but are not limited to:
- 1) Bid and award cycles.
  - 2) Shop Drawing development and approval.
  - 3) Equipment and Materials submittal preparation and approval
  - 4) Equipment and Materials, fabrication, factory acceptance testing, and delivery.
  - 5) Purchased and Stored Material/Equipment.
  - 6) Material/Equipment delivery requirements by the City.
- c. City Activities: Activities of City and other third-party activities shall be clearly identified in the Project Schedule. These activities include, but are not limited to, the following and the precursor processes:
- 1) Right-of-Way property acquisition and site access.

- 2) Submittal reviews.
  - 3) Inspections and tests as necessary.
  - 4) Environmental permit approvals by regulators.
  - 5) Notice to Proceed.
  - 6) Delivery of City-furnished material/equipment.
- d. Construction Activities: Construction activities shall be resource and cost loaded as described in this Section and shall include, but not be limited to:
- 1) Mobilization or demobilization.
  - 2) Installation of temporary and permanent Work by trades, areas, and facilities as described in the Contract Documents.
  - 3) Activities to describe the Work in sufficient detail identified according to the WBS.
  - 4) Testing and inspections of installed work by technicians, inspectors or engineers as well as the outages.
  - 5) Final clean-up.
  - 6) Scheduled Substantial Completion.
- e. Commissioning and Integration Testing Activities shall be resource and cost loaded and shall include, but not be limited to:
- 1) Start-up and Testing of equipment and systems.
  - 2) Commissioning of building and related systems.
  - 3) Scheduling of specified manufacturer's representatives.
  - 4) Dynamic Testing Readiness.
  - 5) Pre-Final inspection.
  - 6) Final Acceptance inspection.
  - 7) System Demonstration Performance Tests.



- 8) Training to be provided.
- 9) Administrative tasks and processes necessary to start, proceed with, accomplish, or finalize the Work.

C. Activity Durations:

1. Contractor shall maintain individual schedule activity durations of 20 work days or less.
2. Activities exceeding 20 work days in duration shall contain appropriate production projections so that entries can be maintained, and remaining durations adjusted according to physical progress.
3. Items such as Procurement, Fabrication, and Delivery activities may exceed 20 work days with the approval of City.
4. The Contractor is not permitted to modify (increase or decrease) an activity's original duration after it is approved by the City. During the monthly updating process, only the activity's remaining duration may be modified.

D. Summary Level Activities

1. Contractor may use Summary Level activities to represent the Work under the following conditions:
  - a. In the Preconstruction Schedule, those activities starting at least 180 days after the NTP or as otherwise agreed with the City.
  - b. In the Project Schedule and Monthly Progress Schedules, those activities starting at least 360 days after the NTP or as otherwise agreed with the City.
  - c. Summary Level activities should not exceed 90 work days without City approval and shall match the Work Breakdown Structure.
  - d. All Summary Level activities shall be detailed and supported by appropriate key resource information resource and cost loaded as agreed to in the Scheduling Conference.
  - e. Contractor shall replace Summary Level activities in the Preconstruction and Proposed Project Schedule with detailed activities through an updating process as the information becomes available and as the above-defined or agreed day limits roll forward.
2. Activity Relationships/Use of Constraints, Lags and Milestones

**CONSTRUCTION SCHEDULES**

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- a. Except for the Notice to Proceed and Project Completion milestone activities, no activities shall be open-ended, open-start or open finish. Each activity shall have predecessor and successor relationships to present sequence of work and movement of resources (hard and soft logic). Once an activity exists on an approved Project Schedule it may not be deleted, renamed, or renumbered, unless approved by City.
- b. Finish-to-Start relationships shall be the primary relationship used in all Project Schedules unless valid reasons are demonstrated for other logic relationships. Start-to-Start with lags shall be permitted provided the lag is updated and no gaps exist between contiguous activities due to the lag. Activities linked to successors only with Start-to-Start relationships shall not be permitted and must also include a Finish-to-Start or Finish-to-Finish relationship with one or more successors. Finish to Start relationship with lag shall not be permitted.
- c. Lags shall not be used when the creation of an activity will perform the same function (e.g., concrete cure time). Use of lag must be minimized and restricted to only those situations where it is not possible to properly define the start or finish of an activity by the use of a normal Finish-to-Start, Start-to-Start or Finish-to-Finish relationship. Duration of a lag shall not exceed the duration of the predecessor activity. Negative lags shall not be permitted. Contractor shall identify any lag proposed and provide an explanation for the purpose of the lag in the activity notebook and Narrative Report.
- d. Date/time constraints, other than those required by the Contract Documents, shall not be used unless jointly agreed to by City and Contractor. If Contractor seeks approval to include constraints in the schedule, Contractor shall identify any constraints proposed and provide an explanation for the purpose of the constraint in the activity notebook and Narrative Report.
- e. Actual Start and Finish dates shall not be automatically updated by default mechanisms that may be included in the CPM scheduling software system. Actual Start and Actual Finish dates shall be included on the Monthly Progress Schedule and shall be consistent with other project reporting, such as daily reports, and the Contractor's monitoring and performance measuring system. In-progress activities will be updated by revising the activity's remaining duration according to actual measured or estimated work progression.
- f. Allowable activity dates are early start, late start, early finish, late finish, actual start, and actual finish. Use of activity dates such as "expected" are prohibited.
- g. Float Suppression techniques (i.e. as late as possible constraints) shall not be allowed. All Float shall be shown in the Project Schedule. Float shall be monitored, accounted for, and maintained in accordance with this Section.

- h. Activity constraints or use of activity durations, logic ties and sequences unapproved by the City shall not be used in any Project Schedule.
  3. Resource Loading Project Schedule
    - a. The Activities within the construction schedule shall be resource loaded with key quantities and updated on a weekly basis to track the production of construction activities. The update of key quantities will be used to track Key Performance Indicators (KPIs) set forth by the PMT.
- E. Software Settings
1. De-Link Remaining Duration and Percent Complete. Construction activity progress will be calculated using Remaining Duration and Physical Percent Complete.
  2. Set Resource Data to “Two decimal places”.
  3. All activity durations and Float values will be shown in days.
  4. Schedule calculations and Out-of-Sequence progress (if applicable) shall be handled through Retained Logic, not Progress Override and not Actual Dates. Out- of-Sequence activities shall be updated to reflect actual project conditions.
  5. Date format will be DDMMYY (i.e., 01DEC15.)
  6. Default activity type will be set to “Task Dependent”.
  7. The Duration Type for each activity shall be set to "Fixed Duration and Units" before assigning any costs or resources to the activity.
- F. Activity IDs
1. The naming and coding of activities will strictly be per the City policies, standards and procedures, as applicable. Activity IDs shall be provided for each Activity with up to 15 characters as detailed in the City Policies, Standards and Procedures, as applicable. The purpose of the structure for the Activity ID is for easier identification and for improved organization in all Project Schedules. Each part of the ID will also need to be included in the schedule as an activity code.
  2. Activity IDs shall not be deleted and/or re-assigned. If during the course of the project, an activity is needed to be deleted, that Activity shall move to the inactive WBS titled “Deleted Activities” in order to avoid re-using of the same Activity IDs, should the need of adding new activities arise.
  3. Activities to be deleted: Remove logic, relationships and Activity Codes.

G. Activity Names

1. Activity

- a. Location - Verb Names shall be brief but shall convey the scope of work described. Non- Standard abbreviations shall be explained in the Narrative Report. Percentages shall not be used in activity descriptions (e.g., Pour West Footing (0 - 50%)) unless the City agrees with the use of percentage for a particular activity. Contractor shall submit samples of activity names for approval prior to establishing the schedule.
- b. All activities shall have a unique activity name/description.
- c. Activity names can only be modified to add detail describing an activity's scope, correct the spelling or grammar, or to improve for clarity, but cannot be revised to completely change the scope of the activity.
- d. Each activity name should follow the following format:
  - (1) Noun.
  - (2) Station numbers, column numbers, or other description for the location, may be included at the end of the activity name if it will provide a better description of the activity.
- e. Example values for Location include but are not limited to:
  - (1) Segment Number.
  - (2) Column Line Numbers.
  - (3) Stationing Value.
  - (4) Other Unique Identification schemes.
- f. Examples of Verbs include, but are not limited to:
  - (1) Design.
  - (2) Install.
  - (3) Procure.
  - (4) Fabricate.

- (5) Deliver.
- (6) Erect.
- (7) Describe the work being performed.

H. Work Breakdown Structure

1. Activities in Project Schedules shall be tied to the Work Breakdown Structure as provided in the City Policies, Standards and Procedures, as applicable.

I. Activity Codes

1. The purpose of the activity codes is to further sort and filter the schedule activities to enhance reporting capability. The activity codes required include both those that are already part of the Activity ID and those that are not.
2. Activities shall be coded as indicated in the City Policies, Standards and Procedures, as applicable.

J. Resource Loading

1. Resource loading shall be done on every construction activity, representing quantifiable work or materials of that Work Package.
2. Each resource-loaded activity shall have an estimate of the key quantities.
3. Failure to incorporate resource loading and establish planned productivity and/or production rates (defined as the planned quantity of work to be executed in a given time), may result in the Contractor's waiver of any right to compensation and time extension for loss of productivity. Submission of any such claim may be rejected for failure to establish baseline productivity by which any claimed loss would be measured.
4. Failure to incorporate resource loading and establish planned productivity may also result in the rejection of any schedule by the City Engineer.

K. Schedules as the Basis for Payment

1. The approved Project Schedule of Values shall be the basis for monitoring and calculating the Contractor's progress during each update period and therefore the amount of each progress payment. Lack of an approved Project Schedule or Monthly Progress Schedule Update will result in the inability of the City to evaluate contract progress for the purposes of payment. Failure of the Contractor to provide all

information, as specified in this Section, will result in the disapproval of the Monthly Progress Schedule (City Engineer may decline to certify payment and may withhold request for payment in whole or in part as set forth in the General Conditions, Article 9, Subparagraph 9.7.3.).

2. Percent complete for activities in the Schedule of Values shall be based on proportion of the overall quantity of the physical work complete. Contractor and City to jointly assess and agree on actual values for easily discernible units of measure (square feet, each, linear feet) on a weekly basis.

L. Cash Flow Report

1. The Contractor shall generate Cash Flow Reports based on each submitted Project Progress Schedule. Report shall be grouped and formatted to be consistent with the approved schedule of values from the contract. Reports shall indicate a time-phased distribution of Schedule of Values. Alternate Cash Flow Reports, if requested by the PMT, shall be submitted for approval prior to submission of the first report.
2. The Cash Flow Report shall display in tabular and graphic format, projections of monthly values of anticipated cost. Each schedule of values line item is to be represented within the project. The Cash Flow Report should also contain the adjusted forecast of estimated costs to achieve completion of the project.

M. Use of Float

1. Float shall be monitored and accounted for. The Float in any schedule shall not be considered for the exclusive use of either the City or Contractor; rather it is for the benefit of the Project. As such, Float is considered an expiring resource available to both parties on a nondiscriminatory basis, so long as the parties act in good faith and work in the best interests of completing the Project on time.

N. Contractor and City Responsibilities for Schedules and Acceptance

1. Any schedule or schedule update rejected or otherwise marked by the City as requiring revision and resubmission shall be revised by the Contractor and resubmitted within 5 days of such revision or resubmission Notice by the Project Manager. Any schedule or schedule update that has not been approved or accepted is presumed lacking a reasonable degree of accuracy and will not be considered by the City to be reasonable, feasible, or accurate when used by Contractor as a basis for a Time Impact Analysis or other type of delay analysis or claim.
2. If Contractor fails to submit its initial construction schedule or monthly schedule updates, or any such schedule or updates are not acceptable to the City, the City Engineer or Director may take such action to decline certifying payment and may withhold request for payment in whole or part) as set forth in Article 9 - General

Conditions, §9.7.3 or any other remedy set forth in the Contract or at law of equity.

3. Contractor Responsibilities

- a. Contractor shall have the responsibility to develop and update the schedules according to all requirements described herein. All schedules shall accurately represent to the City the Contractor's plan for execution of Work. Contractor shall use the most current Project Schedule to execute the Work in compliance with Contract Documents.
- b. In developing and updating the Project Schedules, Contractor represents that it shall require its Subcontractors to actively participate in such development and updating processes. The Contractor represents that all schedules are consistent with Contractor-approved Subcontractor schedules with sufficient agreed details.
- c. Contractor is required to provide its Subcontractors' schedules and updates in native format upon request by City.
- d. Costs incurred by the Contractor in complying with the requirements of this Section or other scheduling obligations contained in the Contract Documents, including but not limited to Contractor's Scheduler, and preparation of all Project Schedules, creation of Recovery Schedules, and the preparation of Time Impact Analysis shall be included in the Contract Price, and shall not be the subject of requests to the City for contractual relief.

4. City's Responsibilities

- a. All Project Schedules shall be submitted to the City for review and approval, consistent with the specific requirements set forth herein. The City shall have the right to disapprove any schedule if the schedule fails to comply with the requirements herein, provided, that such disapproval is based on a reasonable determination by the City that such schedule contains deviations from the specifications. City shall have the right to waive what it considers to be, in its sole discretion, minor defects in a schedule. City recognizes its responsibility to act in a reasonable manner with respect to approvals and agrees that approvals shall not be unreasonably withheld (i.e. for matters that do not impact the effective functioning of the schedule.)
- b. Any approval by City of the schedules submitted by the Contractor to City shall mean that in the opinion of the City, Contractor has complied with the requirements of this Section. No such review shall release or relieve the Contractor from full responsibility for the accurate and complete performance of the Work, including the accuracy and completeness of the schedules, or any other duty, obligation or liability imposed on it by the Contract including, the responsibility for completing the Work within the time set forth in the Contract. The review or

approval will not constitute a representation by City that the Contractor will be able to proceed or complete the Work in accordance with the dates contained in submitted schedule.

- c. In reviewing schedules submitted by designers, contractors, or others, the City will review the schedules to determine if the respective schedule appears “feasible and reasonable”; and, determine if the services or work could logically be accomplished in the time frames allotted in the schedule. Approving, accepting, or assenting to (hereafter referred to collectively as “approval” or “approving”) a schedule only means that the City considers that the schedule appears “feasible and reasonable.”
  - d. By approving a schedule, the City is not agreeing that the work or services will be accomplished according to and within times set forth in the schedule. Nor by approving a schedule does the City accept or bear some responsibility or liability if the work or services are not accomplished according to and within times set forth in the schedule or if factors upon which the schedule is based thereafter change during the execution of the works or services. Approval of any schedule showing completion beyond milestone dates and/or beyond contract completion times indicated in the contract shall not change any milestone or completion times in the contract and approval of a schedule is without any prejudice to the rights of the City.
- O. Schedule Workshops and Review Meetings
1. A record of all Schedule Workshops and Schedule Review Meetings shall be made by the Contractor stating the place and time of the meeting, the names and identification of those present, and a description of the topics discussed, and the agreements reached. Meeting minutes for these meetings, subject to the City’s review and approval, shall be prepared immediately after the meeting and issued within three days, with distribution to the City and all attendees.
  2. Project Scheduling Workshops:
    - a. Proposed Schedule Workshop
    - b. Contractor shall meet with the City within 14 days after the Notice to Proceed for Preconstruction Services to conduct a Post-Award Kick-Off Meeting and Project Scheduling Workshop to review and coordinate schedule requirements including, but not limited to, the following:
      - (1) Review software limitations and content and format for reports.
      - (2) Verify availability of qualified personnel needed to develop and update schedule.



- (3) Discuss physical constraints to the project, including phasing, work stages, area separations, and interim milestones.
- (4) Review delivery dates for City-furnished products.
- (5) Review of Contractor and Subcontractor procurement cycles and their work plans.
- (6) Review schedule for work of the City's separate contracts.
- (7) Review submittal requirements and procedures.
- (8) Review time required for review of submittals and re-submittals.
- (9) Review requirements for tests and inspections by independent testing and inspecting Governmental Authority(s)
- (10) Review time required for Project closeout and City startup procedures, including commissioning activities.
- (11) Review and finalize list of construction activities to be included in schedule.

c. Baseline Schedule Workshop

- (1) Contractor shall meet with the City within 30 days after the Notice to Proceed for Construction Services to conduct another Post Award Kick-Off Meeting and Project Scheduling Workshop. This Workshop shall involve scheduling personnel from Contractor and City with the objective of working together to establish procedures for the development of the Baseline Schedule, and to ensure that the City requirements are satisfied and to review and coordinate schedule requirements Contractor shall present the draft Baseline Schedule including a description of intended methodology and assumptions used to accomplish the Work. Presentation shall include:
  - (a) Contract scope.
  - (b) Submittals with City's review.
  - (c) Activity durations.
  - (d) Logic.
  - (e) Activity coding.
  - (f) Weather assumptions.

- (g) Resource Loading
- (h) Cost Loading and Resource Loading
- (i) Performance and Progress measurement.
- (j) Consequence of potential risks including:
  - (i) Long lead times (procurement/deliveries).
  - (ii) Labor and materials shortages.
  - (iii) Accidents.
- (k) Environmental factors.
- (l) Contractor's plan to mitigate any potential risks should they occur.
- (m) Establish Key Performance Indicators (KPI's) for actual progress compared to projected progress.
  - (i) Workshops shall be conducted no more than every 14 calendar days, until the Baseline Schedule is accepted and approved by City.

P. Joint Monthly Progress Schedule Review Meetings

1. Joint Project Status and Monthly Progress Schedule Review Meetings will be held between the City and Contractor consistent with the Contractor's submission of a Monthly Progress Schedule. Contractor is responsible for gathering all supporting documentation, presenting the data for the applicable Monthly Progress Schedule and recording the meeting minutes. The primary purpose of these meetings shall be to review the Monthly Progress Schedule, the monthly Pay Application, and construction progress, including but not limited to:
  - a. Actual start and finish dates of work accomplished, or actual start date and physical percent complete. Identify activities started and completed during the previous period and enter the Actual Start and Actual Finish dates. It shall be understood that Actual Start is defined as the date that work begins on an activity with the intent to pursue the work represented by the activity to its substantial completion, and Actual Finish is defined as the date that the activity's work is complete.
  - b. The amount of the Work remaining for the next period as incorporated in the schedule. Indicate activity progress and/or revise remaining duration (in

**CONSTRUCTION SCHEDULES**

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workdays) to update each activity started, but not completed (remaining duration.) The remaining duration of an activity shall over-ride the calculated percent complete of an activity's duration when preparing the Monthly Progress Schedule.

- c. Changes in the critical path(s) of the schedule.
  - d. Modifications that affect durations, sequencing or logic of activities for which the City, Governmental Authority(s) or other third parties are responsible.
  - e. The assessment of any delays to Longest Path(s).
  - f. Determination of delays, and, as applicable, adjustment of Force Majeure Reserve.
  - g. All other schedule changes as reflected in the accompanying narrative will be reviewed for relevance and effect on remaining Work.
  - h. Resource constraints, if any and proposed work-around sequences.
    - (i) Review proposed schedule changes, future Work and potential problems or impact.
    - (j) Review the Application for Payment to determine the accuracy of, in accordance with the Project Schedule, all progress achieved, the satisfaction all requirements relating to invoicing for Stored Materials, Time and Material (T&M) Change Orders, and whether it is otherwise complete and accurate.
- Q. Modifications – Time Impact Analysis
- 1. Proposed modifications, including potential delays that are anticipated or experienced shall be submitted to City. Contractor has a duty to mitigate delays through modified sequences to minimize cost and time impact caused by the change or potential delay.
  - 2. The Contractor shall prepare a Delay Analysis for each modification, potential delay, delay event, or Contractor request that may affect the Scheduled Substantial Completion Date. The Delay Analysis shall be developed and submitted in accordance with Contract Documents or as requested by City and shall conform to all scheduling principles described in this Section. Preparation of Time Impact Analyses is considered part of construction process and shall be performed at no additional cost to City.
  - 3. Delay Analysis methodology shall follow the guidelines contained in the Association for the Advancement of Cost Engineering International (AACEI) Time Impact Analysis as Applied in Construction.
  - 4. City will strive to approve or reject each Delay Analysis within ten Work Days after

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- receipt of each Time Impact Analysis, unless subsequent negotiations are required, or multiple analyses are submitted at one time. Upon Approval, a copy of the Time Impact Analysis signed by City shall be returned to Contractor and incorporated into Schedule at next Monthly Progress Schedule update which will then become the current approved Schedule.
5. Delay Analysis shall meet requirements for submittal of Schedules including a Fragnet, with sufficient supporting documentation to enable City to make a determination of Contractor's request for a time extension.
  6. Upon execution of a Change Order adjusting the Schedule Substantial Completion Date, the agreed upon event and impact shall be included in the next Monthly Progress Schedule if the parties agree to the extent of the impact. Changes in the schedule should be clearly identifiable by specific Activity IDs and activity coding and Work Breakdown Structure for changes as agreed upon with City. Inclusion of changed conditions shall conform to all scheduling principles noted in this Section. Changes included as an adjustment to the existing schedule activity durations are not allowed.
  7. Once the Delay Analysis has been approved, the activities associated with that Time Impact Analysis should be added to the next Monthly Progress Schedule or Look-Ahead Schedule.
  8. If the parties are unable to reach an agreement about how to forward-look the effect of the impact on the Monthly Progress Schedule's Critical Path(s), City may allow the Contractor to insert a Fragnet into the schedule on a preliminary basis following agreement of the proposed Fragnet activities. The duration of the Fragnet activities and/or the impact to the Scheduled Substantial Completion Date will be adjusted through the monthly update process as the actual duration of the delay becomes known.
- R. Other Schedules
1. The Contractor may use other schedules and report in other formats to manage its work on a day-to-day basis, but these other schedules do not represent or replace the Project Schedules as specified in this Section.
- 8.01 PRE-CONSTRUCTION SCHEDULE
- A. When Preconstruction Services are to be provided by the Contractor, upon receipt of the NTP for Preconstruction Services, Contractor shall prepare a Preconstruction Schedule which includes those activities prior to approval to proceed with construction activities.
  - B. The Preconstruction Schedule shall include the activities described in the plans developed during Preconstruction including design plans, subcontracting plans, procurement plan, construction plans and development and negotiation of a Guaranteed Maximum Price (if

applicable) at a summary level which can be replaced with detailed information as the Project Schedule is finalized and the construction is authorized.

## 8.02 PROJECT SCHEDULES

### A. Proposed Project Schedule

1. Prepare an initial Proposed Project Schedule (Proposed Schedule) representing the Contractor's plan for the Work in accordance with the requirements of this Section. The Proposed Project Schedule will include the elements of the Preconstruction Schedule and be the initial draft of the Project Schedule. The Proposed Schedule will be the basis for Monthly Progress Schedules and monthly Pay Applications until the approval of the Baseline Schedule.
2. The Proposed Schedule shall be updated on a monthly basis until the approval of the Baseline Schedule after which the Baseline Schedule becomes the Project Schedule.

### B. Baseline and Project Schedule

1. The Baseline Schedule is the Project Schedule at the point in time when the Contractor and City agree and approve the Proposed Schedule as the accepted basis for the Project. Requirements described in this subsection shall apply to the all Baseline Schedule submissions.
2. Baseline Schedule submitted by Contractor and approved by the City shall contain no progress for any activities and shall have a Data Date of the Notice to Proceed date.
3. Prepare a draft Baseline Schedule after the Baseline Schedule Workshop has been conducted.
4. Within 14 calendar days after the draft Baseline Schedule is accepted the Contractor shall provide its final Baseline Schedule for City's review and comments.
5. The final Baseline Schedule submission shall include the following:
  - a. The approved final Baseline Schedule shall be version 00.
  - b. One full-color time-scaled network document in PDF format organized by WBS. Print sizes shall be 11 inches by 17 inches standard sized sheets. Provide following information on the document:
    - (i) Activity ID.
    - (ii) Activity Description.
    - (iii) Original Duration.

- (iv) Remaining Duration.
- (v) Duration Percent Complete.
- (vi) Early Start.
- (vii) Early Finish.
- (viii) Late Start.
- (ix) Late Finish
- (x) Total Float
- (xi) Activities Gantt Chart

6. The Baseline Schedule narrative which shall address the following:
- a. Description of the Contractor's plan to perform the work through the entire contract performance period.
  - b. Description of primary, secondary and tertiary Critical Paths.
  - c. Explanation of calendars used, including days of the week, holidays, etc.
  - d. Discuss calendar assignment to activities.
  - e. Description of major pieces of equipment that will be used on the site.
  - f. Discuss procurement of long lead items.
  - g. A discussion of monthly cash flow planned costs, and cumulative expenditures.
  - h. A general description of the means and methods proposed for the execution of the Work including, but not limited to:
    - (1) Discussion of operating areas and the proposed sequences.
    - (2) Description of the planned crews - sizes, equipment used, etc.
    - (3) Number of shifts to perform the Work.
    - (4) Significant activities that may inhibit the Work.
    - (5) A listing of all milestones.

7. Contractor shall represent that the final Baseline Schedule is an accurate representation of Contractor's plan for performing the entire Work and that Contractor intends to use such schedule to execute the Work in compliance with the Contract Documents. Once the final Baseline Schedule is accepted it shall be the initial Project Schedule and used as the baseline in the Monthly Progress Schedules.

C. Monthly Progress Schedules

1. Monthly Progress Schedules are Project Schedules with progress achieved indicated for each Activity.
2. Project Schedules shall be progressed (updated) on a monthly basis until Final Acceptance is accomplished. Progress of Schedule activities shall be a physical percent complete as agreed with the City.
3. The Contractor shall not reduce activity durations in an attempt to reduce negative float. If the Contractor intends to execute activities quicker than the original duration, this shall be mentioned in the float analysis.
4. Approved Changes shall be included in each Monthly Progress Schedule.
5. Contractor shall meet with City each month in a Joint Monthly Progress Schedule Meeting,
6. Contractor shall make two submittals (Progress Only and Contractor's Adjusted) of the Project Schedule each month:
  - a. Shall incorporate the Contractor's Monthly Update (i.e. logic, durations, and calendar) made to the schedule including progress update information. This submission shall follow the scheduling principles described in this Section.
7. Each version of the Monthly Progress Schedule submitted by the Contractor shall require approval by City.
8. The Data Date for the Monthly Progress Schedule is 00:00 hours on Saturday following the last Friday of the Month. For each update of the Proposed and Baseline Schedules, the Version number shall increase by 1, and the previous schedule shall be archived to permit an audit trail.
  - a. Designations for the Progress Only (PO) and the Contractor's Adjusted (CA) shall clearly define the submission.
  - b. City will review and approve Monthly Progress Schedules based on remaining durations provided for each activity.

- c. Each Monthly Progress Schedule (PO and CA) shall contain activity progress measured through the Data Date and shall be submitted to the City for its review.
9. The City will review the Monthly Progress Schedule and provide comments at the Joint Monthly Progress Schedule Meeting to be held five working days after submission of the Monthly Progress Schedule.
10. Monthly Progress Schedule submissions shall be comprised of the following:
  - a. One full-color time-scaled network document in PDF format organized by WBS. Print sizes shall be 11 inches by 17 inches standard sized sheets.

Provide following information on the document:

- (1) Activity ID.
  - (2) Activity Description.
  - (3) Original Duration.
  - (4) Remaining Duration.
  - (5) Duration Percent Complete.
  - (6) Early Start.
  - (7) Early Finish.
  - (8) Late Start.
  - (9) Late Finish.
  - (10) Total Float.
- b. The Monthly Progress Schedule narrative shall address the following:
    - (1) Description of the Work completed by the Contractor in the past performance period and Contractor's plan to perform the work through the entire next performance period, including shift work.
    - (2) Description of primary, secondary, and tertiary Critical Paths.
    - (3) Description of problem areas and anticipated problem areas and an explanation of corrective actions taken or planned to be taken.



- (4) Current and anticipated delays including cause of delay, corrective actions taken, and impact of delay on other activities, milestones, and completion dates.
- (5) Pending items (Minor Changes in the Work, Change Orders, Time Impact Analyses) and status thereof.
- (6) A list of fully executed Changes issued by the Wednesday of the week before the last Friday of every reporting period.
- (7) A description of any changes made to the schedule and reasons.
- (8) A narrative to show revisions since previous submissions for changes in scope of work, sequencing and other identifiable changes.
- (9) Progress made on critical activities indicated on CPM schedule.
- (10) Status of critical project components (percent complete, amount of time ahead or behind schedule) and if delays have occurred provide an analysis of how they may be mitigated.
- (11) Explanations for any lack of work on critical path activities planned to be performed during last month. Identify any changes to the critical path and the drivers for each change.
- (12) List of critical activities scheduled to be performed next month.
- (13) Status of major material and equipment procurement.
- (14) Any delays encountered during the reporting period.
- (15) Updated schedule duration uncertainty to coincide with the Project status and risk exposures.

D. Look-Ahead Schedules:

1. The Look-Ahead Schedule shall be the actual detailed work plan used by the Contractor in meeting the Contract schedule and milestones. The Look-Ahead Schedule shall be an element of the Contractor's Project Schedule.
2. The Look-Ahead Schedule shall be the basis of the weekly Progress Meetings.
3. The Look-Ahead Schedule shall display:
  - a. Past Week Activities

- b. Current Week Activities
  - c. Three Week Look ahead Activities
  - 4. Look-Ahead Schedules shall include as-built data, forecasted activity sequences, activity durations, through the Scheduled Substantial Completion Date and Final Acceptance, demonstrating the entire scope of Work.
  - 5. In months coinciding with a Look-Ahead Schedule submission, PO Monthly Progress Schedule shall be based on the last approved Monthly Progress Schedule
  - 6. Submission of Look-Ahead Schedules shall not replace the requirement for Contractor to prepare a Time Impact Analysis indicating delay to Scheduled Substantial Completion Date.
- E. Commissioning and Integration Testing Schedule:
- 1. Testing and Commissioning is expected to be carried as a summary activity in the Baseline Schedule and Project Schedules until a draft Commissioning and Integration Testing Schedule shall be submitted not later than 90 days prior to the first testing / commissioning before the Scheduled Substantial Completion Date.
  - 2. A final Commissioning and Integration Testing Schedule shall be submitted no later than 60 days prior to the first testing / commissioning activity before the Scheduled Substantial Completion Date and upon approval shall be incorporated into the Project Schedule with a Monthly Progress Schedule.
  - 3. The Commissioning and Integration Testing Schedule shall display scheduled Work so that each activity is shown with duration of no more than 15 workdays.
- F. Recovery Schedule
- 1. Should any of the following conditions exist, City may require the Contractor to prepare, at no extra cost to City, a plan of action and a Recovery Schedule as to how the Contractor plans to reorganize its work and resources to complete the Work by the Scheduled Substantial Completion Date and recover any lost time and/or delays that have been determined by the City to be caused by the Contractor:
    - a. Contractor's monthly progress report indicates delays that are, as determined by City, of sufficient magnitude that the Contractor's ability to complete the Work by the Scheduled Substantial Completion Date is brought into question.
      - (1) If the Work is delayed on the Critical Path item for a period which exceeds the greater of either a) thirty (-30) days in the aggregate, or b) that number

**CONSTRUCTION SCHEDULES**

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of days in the aggregate equal to five percent of the days remaining until the approved Substantial Completion. For example, If the remaining duration during the period update is 300 Days, then five percent of the remaining 300 Days is 15 Days. The greater of (-30) days or (-15) days is (-15) days.

- (2) Contractor 's performance and resource utilization are not as planned to result in unnecessary consumption of the float.
  - (3) Contractor desires to make changes in the logic (sequencing of Work) or the planned duration of future activities in the schedule to recover lost time.
- b. Contractor shall submit a Recovery Schedule according to the requirements described in this Section. A Recovery Schedule, when required, shall be submitted to City for review and approval within 21 calendar days of Contractor receiving City's written request.
- c. Changes included in Recovery Schedule shall be documented. Contractor shall submit to City an audit report that has been prepared using schedule comparison software (i.e. Claim Digger, Project Investigator, or other software approved by City.
- d. If a recovery schedule is required hereunder, the City, at its sole discretion, may withhold the Contractor's Fee for that period in the Payment Application until such time the Contractor has prepared, and the City has accepted such recovery schedule.
- e. The Recovery Schedule submission shall include the following:
- (1) Detailed narrative describing (with an explanation for the reason of) any revised sequences, durations, and resources.
  - (2) Anticipated effect of revision on the current Project Schedule and Scheduled Substantial Completion Date, including describing change in affected activities' Total Float value.
  - (3) Contractor shall furnish sufficient labor, resources and equipment to ensure the prosecution of the Work meets the current Scheduled Substantial Completion Date. If in the opinion of City, Contractor falls behind in the prosecution of the Work as indicated in the current Schedule, Contractor shall take such steps as may be necessary to improve its progress. City may require Contractor to increase the number of shifts, days of work, and/or the amount of plant and equipment, all without additional cost to City.
  - (4) If Contractor fails or refuses to implement such measures to bring the Work back to conformity within the Scheduled Substantial Completion Date, City shall have the right to declare such failure or refusal a Contractor Event of

Default under the Contract.

G. Revised Baseline Schedule

1. Either City or Contractor may request a Revised Baseline Schedule (Re-Baseline Schedule). The Monthly Progress Schedule to reflect actual progress shall not be considered as a Revised Baseline Schedule.
2. A Revised Baseline Schedule is considered necessary under the following conditions:
  - a. Additions, deletions, or revisions to activities required by Contract modification.
  - b. City determines there is reasonable doubt that milestones or the Scheduled Substantial Completion Date will be met. A Schedule Revision shall demonstrate how Contractor intends to reschedule remaining work by the Scheduled Substantial Completion Date. There shall not be additional cost to City, through re-sequencing and reallocating its forces to complete Work by Scheduled Substantial Completion Date.
3. Revised Baseline Schedule, when required, shall be submitted to City for review and approval within 21 days of Contractor receiving City's written request.
4. Revised Baseline Schedule shall conform to all requirements described in this Section for Project Schedules and shall include:
  - a. An audit report that has been prepared using schedule comparison software (i.e. Claim Digger, Project Investigator, or other software approved by the City.)
  - b. Detailed narrative explaining reason for revision.
  - c. Anticipated effect of the Revised Baseline Schedule on the Scheduled Substantial Completion Date, including describing change in affected activities Total Float value.
  - d. Appropriate Fragnet demonstrating the necessary changes.

H. As Built Schedule

1. Contractor shall prepare and submit an As-Built Schedule documenting actual start and actual finish dates for all activities and logic ties for all activities to show actual sequence in which Work was performed.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01326**  
**CONSTRUCTION SEQUENCING**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Work periods.
- B. Mobilization and demobilization.
- C. Construction sequence.

**1.02 WORK PERIODS**

- A. No work is permitted at [HOU] during the following periods:
  - 1. Beginning at 6:00 a.m. CST (0600 hours) on Tuesday prior to Thanksgiving Day and to 10:00 p.m. CST (2000 hours) the following Monday.
  - 2. Beginning at 6:00 a.m. CST (0600 hours) one week prior to Christmas Day and to 11:59 p.m. CST (2359 hours) January 2 following.
  - 3. Beginning at 6:00 a.m. CST (0600 hours) on Friday prior to Houston Area Spring Break, and to 11:59 p.m. CST (2359 hours) the following Monday. These dates may be adjusted by HAS operations depending on scheduling of Spring Break for Houston Area School Districts.

No pavements shall be closed during these periods. The Contractor shall prepare any closed pavements to be opened during these periods, including, but not limited to, removal of all barricades and pavement closure devices, replacement of pavement markings. Coordinate requirements with HAS operations. This work shall be considered subsidiary to the cost of the project and shall not be measured or paid for separately.

- A. Reference the project phasing sheets of the plan set for details and required work hours, by phase. The contractor is required to complete the work by phase within the calendar days noted in the project phasing sheets of the plan set. Each Bid Schedule will be initiated only with a Notice to Proceed by the Owner. The Notices to Proceed may or may not be numerically sequential and may or may not be issued immediately after completion of the preceding Bid Schedule. The Contractor may not perform work without an authorized Notice to Proceed.
- B. For purposes of on-site construction operations for interior work, work may be accomplished in one or more of the following daily schedules (shifts) and as specified elsewhere herein:

**CONSTRUCTION SEQUENCING**

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1. “Day (D) Shift”: For work fully confined behind dust-resistant enclosures and where airborne or structure-borne noise is abatable by temporarily ceasing operations, work from 0000 hours through 2400 hours each day of the week, meaning a 24 hour shift is available whether or not all hours are used; however, deliver products and remove debris only during “N Shift.”
  2. “Night (N) Shift”: For work that cannot, due to dust or noise-producing operations, be done during “D Shift”, work from 1900 hours through 0600 hours each day of the week (8-hour shift, one-hour lunch break), with the following restrictions on access:
    - a. Move products into and remove debris only during “N shift” period.
    - b. Complete work of the shift and entirely evacuate the work area by 0600 of the next day, including rubbish removal, leaving enclosures or barricades in place.
    - c. Work at the car rental counters at the Baggage Level Public Lobby between 02300 hours to 0500 hours.
- C. For purposes of on-site construction operations for exterior work within the AOA, work shall conform to the following:
1. The contractor shall not perform lane closures with the Terminal Roadways unless approved in advance and in writing by HAS Airport Operations.
  2. Fire station access must be maintained at all times.
  3. Maintain access through work zone to terminal buildings and garages at all times unless indicated on the plans. Temporary closures of any access must only be completed between the hours of 10:00 p.m. CST (2200 hours) to 6:00 a.m. CST (0600 hours) on weekend days unless indicated on the plans. Temporary closures of delivery entrances and exits may only occur from 8:00 p.m. CST (2000 hours) to 4:00 a.m. CST (0400 hours) on weekend days unless indicated on the plans.
  4. The contractor shall coordinate staging areas for equipment with HAS Airport operations.
  5. See additional traffic control sequencing notes in the plans.
- 1.03 MOBILIZATION AND DEMOBILIZATION
- A. Payment for mobilization is specified in Section 01290 - Payment Procedures.
  - B. General mobilization applicable to the Work, regardless of construction sequencing specified herein includes:
    1. Construction and Submittal Schedule processing following Sections 01325 - Construction Schedules and 01340 - Shop Drawings, Product Data and Samples.

**CONSTRUCTION SEQUENCING**

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2. Obtain and pay for permits.
3. Submittal of other documents following Section 01312 - Coordination and Meetings.
4. Survey Base Building Following Section 01726- Base Facility Survey and process related Document 00685- Request for Information, including accessibility by cutting, following Section 01731- Cutting and Patching, into concealed areas.
5. Security badging following Section 01506 - Temporary Controls.
6. Approval of construction schedules following Section 01325 - Construction Schedules.
7. Product acquisition for other tasks; except products with short lead times may be acquired later as required to maintain schedule performance.
8. Acquisition of major construction equipment and set-up of on-site storage and office space.
9. Other activities necessary to maintain schedule performance.
10. Construction of exterior and interior barricades and enclosures following Section 01505 - Temporary Facilities.

C. Demobilization:

1. Processing of closeout documents, following Section 01770 - Contract Closeout, and activities not otherwise completed at the end of previous tasks.

1.04 CONSTRUCTION SEQUENCE

- A. Sequence of work or tasks indicated in the schedule included in the Drawings is intended only as a guide for Bidding.
- B. Prepare and process Contractor's construction schedule following Section 01325- Construction Schedules.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CONSTRUCTION SEQUENCE

- A. Construct the Work in [as shown on Drawings.]

END OF SECTION



**SECTION 01330**  
**SUBMITTAL PROCEDURES**

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submittal procedures for:

1. Construction Schedules and Cash Flow Curve (billing forecast).
2. Shop Drawings, Product Data and Samples
3. Manufacturer's Certificates
4. Construction Photographs
5. Project Record Documents and monthly certification.
6. Design Mixes

1.02 SUBMITTAL PROCEDURES

A. Scheduling and Handling:

1. The Contractor must utilize Microsoft SharePoint, and/or a web-based system run by the Houston Airport System, to submit RFIs, Submittals and Invoices. Before doing so, the Contractor must attend a brief mandatory SharePoint training session, which will be conducted by a member of HAS. The Contractor must contact the designated HAS trainer prior to the start of construction to schedule a time for training. Access to SharePoint will not be given to the Contractor's team until training is completed. All document collaboration will be done using SharePoint.
2. Submit Shop Drawings, Data and Samples for related components as required by Specifications and Project Manager.
3. Schedule submittals well in advance of need for construction Products. Allow time for delivery of Products after submittal approval.
4. Develop submittal schedule that allows sufficient time for initial review, correction, resubmission and final review of all submittals. Allow a minimum of 30 days for initial review. Project Manager will review and return submittals to Contractor as expeditiously as possible, but time required for review will vary

depending on complexity and quantity of data submitted.

5. Project Manager's review of submittals covers only general conformity to Drawings, Specifications and dimensions that affect layout. Contractor is responsible for quantity determination. No quantities will be verified by Project Manager. Contractor is responsible for errors, omissions or deviations from Contract requirements; review of submittals does not relieve Contractor from the obligation to furnish required items in accordance with Drawings and Specifications.
6. Submit five copies of documents unless otherwise specified.
7. Revise and resubmit submittals as required. Identify all changes made since previous submittal.
8. Assume risk for fabricated Products delivered prior to approval. Do not incorporate Products into the Work, or include payment for Products in periodic progress payments, until approved by Project Manager.

**B. Transmittal Form and Numbering:**

1. Transmit each submittal to Project Manager with Transmittal letter which includes:
  - a. Date and submittal number
  - b. Project title and number
  - c. Names of Contractor, Subcontractor, Supplier and manufacturer
  - d. Identification of Product being supplied
  - e. Location of where Product is to be installed
  - f. Applicable Specification section number
2. Identify deviations from Contract documents clouding submittal drawings. Itemize and detail on separate 8-1/2 by 11-inch sheets entitled "DEVIATIONS FOR \_\_\_\_\_." When no deviations exist, submit a sheet stating no deviations exist.
3. Have design deviations signed and sealed by an appropriate design professional, registered in the State of Texas.
4. Sequentially number transmittal letters beginning with number one.
5. Use original number for resubmittals with an alphabetic suffix (i.e., 2A for the first resubmittal of submittal 2, or 15C for third resubmittal of submittal 15, etc.).

Show only one type of work or Product on each submittal. Mixed submittals will not be accepted.

C. Contractor's Stamp:

1. Apply Contractor's Stamp certifying that the items have been reviewed in detail by Contractor and that they comply with Contract requirements, except as noted by requested variances.
2. As a minimum, Contractor's Stamp shall include:
  - a. Contractor's name.
  - b. Job number.
  - c. Submittal number.
  - d. Certification statement Contractor has reviewed submittal and it is in compliance with the Contract.
  - e. Signature line for Contractor

D. Submittals will be returned with one of the following Responses:

1. "REVIEWED AS SUBMITTED" when no response and resubmittal is required.
2. "NO EXCEPTION" when sufficient information has supplied to determine that item described is accepted and that no resubmittal is required.
3. "MAKE CORRECTIONS AS NOTED WHEN EXCEPTIONS DO NOT REQUIRE FUTURE CHANGES" when sufficient information has been supplied to determine that item will be acceptable subject to changes, or exceptions, which will be clearly stated. When exceptions require additional changes, the changes must be submitted for approval. Resubmittal is not required when exceptions require no further changes.
4. "REVISE AND RESUBMIT" when submittal do not contain sufficient information, or when information provided does not meet Contract requirements. Additional data or details requested by Project Manager must be submitted to obtain approval.

1.03 MANUFACTURER'S CERTIFICATES

- A. When required by Specification sections, submit manufacturers' certificate of compliance for review by Project Manager.

- B. Place Contractor's Stamp on front of certification.
- C. Submit supporting reference data, affidavits, and certifications as appropriate.
- D. Product certificates may be recent or from previous test results, but must be acceptable to Project Manager.

1.04 DESIGN MIXES

- A. When required by Specification sections, submit design mixes for review.
- B. Place Contractor's Stamp, as specified in this section, on the front of each design mix.
- C. Mark each mix to identify proportions, gradations, and additives for each class and type of mix submitted. Include applicable test results from samples for each mix. Perform tests and certifications within 12 months of the date of the submittal.
- D. Maintain copies of approved mixes at mixing plant.

1.05 CHANGES TO CONTRACT

- A. Changes to Contract may be initiated by completing a Request for Information form. Project Manager will provide a response to Contractor by completing the form and returning it to Contractor.
  - 1. If Contractor agrees that the response will result in no increase in cost or time, a Minor Change in the Work will be issued by City Engineer.
  - 2. If Contractor and Project Manager agree that an increase in time or cost is warranted, Project Manager will forward the Request for Proposal for negotiation of a Change Order.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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**SECTION 01340**  
**SHOP DRAWINGS, PRODUCT DATA AND SAMPLES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General procedural requirements for submittal data:
  - 1. Shop drawings.
  - 2. Product data.
  - 3. Samples, including control samples.
  - 4. Product certifications and compliance statements.
  - 5. Submittal logging.
- B. Submittal quantities specified in other Sections supersedes those specified herein.
- C. Product interface control documents.

1.02 GENERAL PROCEDURES

- A. Review submittal data and indicate results of review on documents submitted to Designer.
  - 1. Obtain review and indicate results of Subcontractors' and applicable Separate Contractors' reviews before submittal to Designer.
  - 2. Include on each shop drawing, sample or product data submittal the following minimum language, signed (by individuals authorized to make binding agreements on behalf of their respective firms) and dated on behalf of each responsible party:

"The Subcontractor and the Contractor named below hereby certify this submittal has been checked prior to submission to Designer and conforms to the requirements of the Contract Documents for work represented hereby. This submittal does not deviate from requirements of the Contract Documents. It has been checked for: field conditions; correlation of dimensions and quantities; safety precautions; construction means, methods, techniques, schedules, sequences, procedures and fabrication processes; for errors and omissions in this submittal; and for coordination of the work of the trades.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(Subcontractor Firm)  
(Authorized Signature)  
(Date)

-----  
-  
This submittal has also been checked by the following Subcontractors and Separate Contractors for coordination of substrate/superstrate conditions and applicable product interfaces.

(List company names, place authorized signature and date for each.)  
-----

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
(Contractor)  
(Authorized Signature)  
(Date)"

- B. Transmit submittals under original transmittal to Designer, with a copy of the transmittal only to City Engineer. Number each submittal by specification number, for future reference.
1. Furnish number of copies specified herein or in other Sections, for Designer's and City Engineer's records, plus additional copies as the Contractor requires for construction operations and coordination of the Work.
  2. Identify Project, Contractor, Subcontractor, Supplier, and generic name of component or system. Allow space on submittal data to accommodate required stamps by Contractor, applicable Subcontractors, applicable Separate Contractors, Designers, and other reviewers.
  3. Indicate applicable Drawing detail and Section number.
  4. For submittals using SI (metric) measure as the manufacturer's or fabricator's standard, include corresponding Imperial measure conversions. Follow requirements in Section 01610.
- C. After Designer's review, revise and resubmit until resubmittal is no longer required; identify and log changes made to previous submittals.
- D. Distribute copies of reviewed submittals to concerned parties, including Separate Contractors. Instruct recipients to promptly report inability to comply with requirements indicated therein.
- E. Shop Drawings, Product Data and Samples: Follow Contractor's progress schedule for submittals related to work progress. Coordinate submittal of related items. Partial submittals will be returned unreviewed.
- F. Transmit submittals far enough in advance to provide time required for reviews, for securing necessary approvals, for revisions and resubmittals. Allow 14 days after receipt for Designer's review, except where shorter processing time is approved due to extraordinary conditions.

- G. Do not submit data where no submittal requirements occur. Unsolicited submittals will be returned unreviewed.
- H. Incomplete, uncoordinated, inaccurate and illegible submittals, and submittals without evidence of review by Contractor, applicable Subcontractors and applicable Separate Contractors will be returned unreviewed.
- I. Responsibility for costs of Designer's additional reviews resulting from improper submittal data remains with the Contractor, deductible from the Contract Sum or Time by Change Order.

#### 1.03 SHOP DRAWINGS

- A. A. Submit digital documents in PDF format. After Designer's review, reproduce and distribute copies required for the Contractor's use. The Designer will reproduce copies for Designer and City Engineer.
- B. Sheet Size: 8-1/2 x 11 inches minimum; 22 x 34 (Full Size of original drawings) inches maximum.
- C. If CADD is used, prepare documents readable, writable and printable using IBM PC-compatible hardware and software, based on AutoCAD (13 or later versions) or software translated thereto. Provide AutoCAD data disks following Section 01770 - Contract Closeout.
- D. Prepare shop drawings by qualified drafters, accurately and distinctly showing:
  - 1. Field and erection dimensions clearly identified as such.
  - 2. Arrangement and section views.
  - 3. Relation to adjacent materials or structure including complete information for making connections between work under this Contract and work under other contracts.
  - 4. Kinds of materials and finishes.
  - 5. Parts list and descriptions.
  - 6. Assembly drawings of equipment components and accessories showing their respective positions and relationships to the complete equipment package.
  - 7. Where necessary for clarity, identify details by reference to drawing sheet and detail numbers, schedule or room numbers as shown on the Contract Drawings.
- E. Drawing to scale, and accurately represent specific products furnished.

#### 1.04 PRODUCT DATA/MANUFACTURERS' LITERATURE

- A. Submit 4 original copies plus additional copies required for Contractor's use. Designer will retain four copies for distribution to City. Distribute remaining copies.
- B. Mark each copy to clearly identify applicable products, models, options, and other data; supplement manufacturers' standard data to provide information unique to the Work.
- C. When available, submit "SpecData" sheets.
- D. Include manufacturers' installation instructions.
- E. For products specified only by reference standard, give manufacturer's name, product name, model or catalog number, copy of referenced standard, and manufacturer's descriptive technical literature.

#### 1.05 CONTRACTOR-PREPARED SAMPLES

- A. Submit 4 original sets of samples plus additional copies required for Contractor's use. Designer will retain three copies for distribution to City. Distribute remaining copies.
- B. Demonstrate functional and visual characteristics of products, complete with integral parts and attachment devices.
- C. Submit a reasonable range of manufacturers' standard colors, textures, sheens, and patterns for selection where specific requirements are not specified, where deviations are proposed, and where the nature of the product may vary in color, vein or "grain," texture, sheen and other visible characteristics.
- D. Sample characteristics are specified in individual Sections.
- E. Size, unless otherwise specified:
  - 1. Paint and Liquid Coated Products: 8-1/2 x 11 inches; tape edges of samples using gypsum board as the base or substrate.
  - 2. Flat or Sheet Products: 8-1/2 x 11 inches.
  - 3. Linear Products: 11 inches long.
  - 4. Bulk Products: Copy of container label, only where label submittal is specified.
- F. Full size or on-site samples or mock-ups may be used in the Work if approved.

#### 1.06 CONTROL SAMPLES



- A. Certain Base Facility construction establishes performance, product, workmanship, or aesthetic quality requirements for this contract.
- B. Required control samples include:
  - 1. Paint and other applied decorative coatings at sight-exposed surfaces in public spaces, regardless of substrate types; for matching compatibility, color, texture, sheen and other visual and performance characteristics of analogous new work.
- C. Include control samples with submittal to which they apply.
- D. For items transmittable by mail or hand, remove one representative sample, following Section 01312 - Coordination and Meetings, and nondestructively label as "Control Sample." Process following Paragraph 1.06.
- E. Obtain control samples following Section 01731 - Cutting and Patching. The control sample will be returned to the Contractor.
- F. For items impractical to remove or mail, temporarily and non-destructively tag each item in place and maintain until submittal processing is complete. Request submittal evaluation to occur on-site. Include request with submittal to which it applies.
  - 1. Provide temporary facilities following Section 01505 - Temporary Facilities to provide access to and protection of control samples.
  - 2. Handle, store and protect control samples following Section 01610- Basic Product Requirements.
- G. Maintain control samples until applicable new work is completed or until directed.

#### 1.07 PRODUCT INTERFACE CONTROL DOCUMENTS

- A. Following requirements apply where specified in other Sections.
- B. Prepare submittal data as required, to indicate proper interface between work of Subcontractors and Separate Contractors, for products of one Section or Contract required to be supported by or affixed or connected to products of another Section or Contract. Follow Section Paragraph 1.02 for review and processing requirements.
  - 1. Fully describe mating surfaces between products.
  - 2. Fully describe predecessor and successor staging and sequencing of product fabrications and installations.
- C. Field corrections to mating surfaces are not permitted, unless field modification is specified in Sections.

1.08 CERTIFICATIONS AND COMPLIANCE STATEMENTS

- A. Submit 4 original copies plus additional copies required for Contractor's use. Designer will retain three copies for distribution to City. Distribute remaining copies. Include original signature and applicable original seal(s) on each copy.
- B. Certifications may be in the form of recent test results, research reports, reference data, or affidavits, as applicable to certifications required.

1.09 SUBMITTAL LOG

- A. If approved, submittal log may be incorporated into submittal schedules following Section 01325 - Construction Schedules.
- B. Coordinate shop drawings, samples, product data and certifications schedule in Section 01325 - Construction Schedules. Log submittals showing proposed submittal number and expected processing period for each.
- C. Denote submittals requiring special attention, such as requested shorter review time due to extraordinary conditions. Indicate reasons for special attention.
- D. Update and distribute following Sections 01312 - Coordination and Meetings and 01325 - Construction Schedules.

1.10 DESIGNER'S ACTIONS

- A. Comments may be added by Designer to submittal data, to inform the Contractor of detected failure of submittal data to follow contract requirements and the design concept expressed therein.
- B. Commencing work governed by submittal requirements without proper processing of required submittals is the risk of the Contractor.
  - 1. Cost increases attributable thereto are the sole responsibility of the Contractor without increase in Contract Sum.
  - 2. Time increases attributable thereto are the sole responsibility of the Contractor under provisions of Article 9.13 (Liquidated Damages) in Document 00700 - General Conditions.
- C. Responsibility for Contractor's errors and omissions or construction of defective or deficient work remains with the Contractor and is not relieved by Designer's review.
- D. Following is Designer's submittal review statement, which may be affixed to Contractor's submittal by stamp, label or separate sheet:

**DESIGNER'S SUBMITTAL REVIEW STATEMENT**

NO EXCEPTION TAKEN	<input checked="" type="checkbox"/>	MAKE CORRECTIONS NOTED	<input type="checkbox"/>
REJECTED	<input type="checkbox"/>	REVISE AND RESUBMIT	<input type="checkbox"/>
SUBMIT SPECIFIED ITEM	<input type="checkbox"/>	REVIEWED ONLY	<input type="checkbox"/>

SEE TRANSMITTAL FOR ADDITIONAL INFORMATION AS APPLICABLE.


ACTION SHOWN ABOVE IS ONLY FOR CONFORMANCE WITH THE DESIGN CONCEPT OF THE WORK AND WITH THE INFORMATION IN THE CONTRACT DOCUMENTS.

BY APPROVAL AND SUBMISSION, CONTRACTOR HAS DETERMINED AND VERIFIED MATERIALS, FIELD MEASUREMENTS AND CONSTRUCTION CRITERIA, PERFORMANCE AND DESIGN CRITERIA, AND SIMILAR DATA.

DEVIATIONS FROM CONTRACT DOCUMENTS ARE NOT REVIEWED UNLESS SPECIFICALLY REQUESTED IN WRITING BY CONTRACTOR. REVIEW ON RESUBMISSION WILL COVER ONLY DESIGNATED CHANGES ON THIS SUBMITTAL AND OTHER CHANGES CLEARLY IDENTIFIED BY CONTRACTOR WITH AN ENCIRCLEMENT.

REVIEWED BY \_\_\_\_\_ DATE \_\_\_\_\_

SUBMITTAL NO. \_\_\_\_\_



END OF DESIGNER'S SUBMITTAL REVIEW STATEMENT

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CONTROL SAMPLES

A. Reinstall control samples following Section 01731 - Cutting and Patching.

END OF SECTION

**SECTION 01423**

**REFERENCES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General quality assurance related to Reference Standards.
- B. List of references.
- C. List of definitions.
- D. List of phrases.

1.02 QUALITY ASSURANCE

- A. For work specified by association, trade, or Federal Standards, follow requirements of the standard, except when more rigid requirements are specified or are required by applicable codes or by Contract Documents.
- B. Follow reference standard effective on the date stated in Document 00700 - General Conditions.
- C. Submit Document 00685- Request for Information before proceeding if specified reference standards conflict with Contract Documents, or if no standards apply.

1.03 PARTIAL LIST OF REFERENCES

AA	Aluminum Association 900 19 <sup>th</sup> St. N.W. Washington, DC 20006 Ph: 202-862-5100	ASME	American Soc. of Mech. Engrs. Three Park Ave. New York, NY 10016-5902 Ph: 212-591-7733
AASHTO	Amer. Assoc. of State Hwy. Officials 444 North Capitol Street, N.W. #249 Washington, DC 20001 Ph: 202-624-5800	AI	Asphalt Institute Research Park Dr. P.O. Box 14052 Lexington, KY 40512-4052 Ph: 859-288-4960
ACI	American Concrete Institute P.O. Box 9094 Farmington Hills, MI 48333-9094 Ph: 248-848-3700	AITC	American Institute of Timber Construction 7012 S. Revere Pkwy, #140 Englewood, CO 80112 Ph: 303-792-9559
AGC	Associated General Contractors of America 333 John Carlyle St., #200 Alexandria, VA 22314 Ph: 703-548-3118	AISC	American Institute of Steel Construction 1 E. Wacker Dr., #3100 Chicago, IL 60601-2001 Ph: 312-670-2400

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AISI	American Iron & Steel Institute 1101 17th Street, N.W., #1300 Washington, DC 20036 Ph: 202-452-7100	933 N. Plum Grove Road Schaumburg, IL 60173-4758 Ph: 847-517-1200
ANSI	American Natl. Stds. Institute 25 W. 43 <sup>rd</sup> St., 4 Floor New York, NY 10036 Ph: 212-642-4900	EJMA Expansion Joint Manufacturers Assoc. 25 N. Broadway Tarrytown, NY 10591 Ph: 914-332-0040
APA	The Engineered Wood Assoc. 7011 So. 19 <sup>th</sup> , Tacoma, WA 98466 Ph: 253-565-6600	FS Federal Standardization Documents Gen. Svcs. Admin. Specificatns. Unit (WFSIS) 7th and D Streets, S.W. #6039 Washington, DC 20407 Ph: 202-472-2205
API	American Petroleum Institute 1220 L Street, N.W. Washington, DC 20005-4070 Ph: 202-682-8000	HAS (City of) Houston Airport System P.O. Box 60106 (16930 JFK Blvd., 77032) Houston, TX 77205-0106 Ph: 281-233-3000
AREA	Amer. Railway Engrg. Assoc. 8201 Corporate Dr., #1125 Landover, MD 20785 Ph: 301-459-3200	HOU William P. Hobby Airport (Airport Manager) 7800 Airport Blvd. Houston, Texas 77061 Ph: 713-640-3000
ASTM	American Soc. for Testing & Materials 100 Barr Harbor Dr., PO Box C700 West Conshohocken, PA 19428-2959 Ph: 610-832-9585	IAH George Bush Intercontinental Airport Houston (Airport Manager) 2800 N. Terminal Road Houston, TX 77032 Ph: 281-230-3100
AWPA	American Wood-Preservers' Association PO Box 388 Selma, AL 36702-0388 Ph: 334-874-9800	ICEA Insulated Cable Engineer Association P.O. Box 1568 Carrollton, GA 30112
AWS	American Welding Society 550 N.W. LeJeune Rd. Miami, FL 33126 Ph: 800-443-9353	IEEE Institute of Electrical and Electronics Engineers 445 Hoes Lane, or P.O. Box 1331 Piscataway, NJ 08854-1331 Ph: 732-981-0060
AWWA	Amer. Water Works Assoc. 6666 West Quincy Avenue Denver, CO 80235 Ph: 303-794-7711	MIL Military Specifications (see "FS" for address) NACE National Association of Corrosion Engineers 440 1 <sup>st</sup> St. N.W. Washington, DC 20001 Ph: 202-393-6226
BICSI	Bldg. Industry Consulting Svc. Intl. 8610 Hidden River Pkwy. Tampa, FL 33637-1000 Ph: 800-242-7405	NARTE National Association of Radio and Telecommunications Engineers, Inc. 167 Village Street P.O. Box 678 Medway, MA 02053 Ph: 508-533-8333, 800-896-2783
COH	City of Houston 900 Bagby Street (Box 1562) Houston, TX 77251-1562 Ph: 713-837-0311	NEMA National Electrical Manufacturers' Association 1300 North 17 <sup>th</sup> Street, Suite 1847 Rosslyn, VA 22209 Ph: 703-841-3200
CLFMI	Chain Link Fence Mfgs Inst. 10015 Old Columbia Rd., #B-215 Columbia, MD 21046 Ph: 301-596-2583	
CRSI	Conc. Reinforced Steel Institute	NFPA National Fire Protection Association 1 Batterymarch Park, P.O. Box 9101 Quincy, MA 02169-7471

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OSHA	Ph: 617-770-3000 Occupational Safety Health Administration 200 Constitution Avenue, NW Washington, DC 20210 Ph: 866-487-2365	Fox River Grove, IL 60021 Ph: 847-458-4647
PCA	Portland Cement Association 5420 Old Orchard Road Skokie, IL 60077-1083 Ph: 847-966-6200	SSPC The Society for Protective Coatings 40 24 <sup>th</sup> Street, 6 <sup>th</sup> Floor Pittsburgh, PA 15222-4656 Ph: 412-281-2331
PCI	Prestressed Concrete Institute 201 North Wacker Drive Chicago, IL 60606 Ph: 312-786-0300	TAC Texas Admin. Code, Texas Water Development Board Box 13231, Capitol Station Austin, TX 78711-3231 Ph: 512-463-7926
SDI	Steel Deck Institute P.O. Box 25	UL Underwriters' Laboratories, Inc. 333 Pfingston Road Northbrook, IL 60062-2096 Ph: 877- 854-3577, 800-285-4476 UNI-BELL UNI-BELL Pipe Association 2655 Villa Creek Dr., Suite 155 Dallas, TX 75234 Ph: 972-243-3902

#### 1.04 PARTIAL LIST OF DEFINITIONS

**Airport:** Area of land or water used or intended to be used for landing and takeoff of aircraft and includes buildings and facilities. Airports under control of City are certificated by FAA under FAR Part 139 and operate under specific safety requirements applicable to maintenance and construction activities.

**Airport Manager:** Individual delegated by Director of Department of Aviation, with absolute responsibility and authority for overall airport operation and compliance with FAR Part 139. Airport Manager shall communicate with Contractor through City Engineer except in case of emergency when City Engineer is not present. The Airport Manager may delegate responsibilities to other persons, such as airport electricians to coordinate lockouts/tag-outs.

**Air Operations Area (AOA):** Any area of Airport used or intended to be used for landing, takeoff, or surface maneuvering of aircraft, including paved or unpaved areas used or intended to be used for unobstructed movement of aircraft in addition to associated runway, taxiway, or apron. The AOA includes any adjacent areas (such as general aviation areas) that are not separated by adequate security systems, measures, or procedures.

**Airport Security Officers:** 1) Uniformed City of Houston Police (HPD) officers enforcing airport regulations and apprehension of unauthorized personnel in security areas; 2) Non-uniformed federal or local government personnel authorized to test for compliance with existing regulations.

**Air Traffic Control Tower (ATCT):** Person responsible for positive control of aircraft and vehicle traffic, including Contractor's, on and around runways, taxiways, and aprons.

**Base Facility:** Existing structure upon and within which the Work is constructed. "Existing construction" and "existing" mean the same as Base Facility.

1. By way of general description, Base Facility includes sidewalks and pavement; foundations; superstructure columns, beams and floors; exterior and interior walls, partitions and doors; mechanical and electrical systems; conveying systems; interior finish materials.
  - a. Underground structures include sewer, water, gas, fuel and other piping, and manholes, chambers, electrical and signal conduits, ducts, tunnels, manholes and other means of access, foundations and below-ground extensions of surface structures and other existing subsurface Work located within or adjacent to the limits of the Work.
  - b. Surface structures include existing buildings, tanks, masts and poles, navigational aids, walls, bridges, roads, dams, channels, open drainage, piping, wires, posts, signs, markers, curbs, walks, pavements and surfaces for wheeled vehicles (including aircraft), guard cables, fencing, lighting and similar constructs above the ground surface or visible without excavation, demolition or cutting.

DOT: Acronym for U.S. Department of Transportation.

Emergency Medical Service: Operational division of Houston Fire Department.

Emergency Vehicles: ARFF, HPD and EMS vehicles operating in emergency mode.

Federal Aviation Administration (FAA): Agency of U.S. Department of Transportation. FAA also means FAA's Administrator or Administrator's duly authorized representative.

Ground Support Equipment (GSE): Mobile and stationary vehicles and equipment for servicing aircraft.

Navigation Aids (NAVAIDS): Equipment used to locate aircraft and direct movement while airborne.

Public areas: Areas where no accessibility restrictions are imposed, generally including roadways, streets, parking lots and structures, and building interiors up to but not including baggage and passenger checkpoints at concourses.

Secured Area: Any portion of the airport where aircraft operators (and foreign air carriers that have a security program under part 1544 or 1546) enplane and deplane passengers, sort and load baggage, and any adjacent areas not separated by adequate security measures.

Security Areas, Security Identification Areas (SIDAs): 1.) AOA; 2) Secured Areas: Exterior or interior areas the access to which is controlled by authorized security personnel or by keyed or electronic locks, and which may have posted notice of restricted access.

Traffic Activity: In-the-air or on-the-ground aircraft and emergency vehicle activity that, determined by ATCT, Airport Manager or City Engineer because of safety reasons, prohibits the start, continuation or completion of construction operations.

Transportation Security Administration (TSA): Agency of U.S. Department of Transportation charged with implementing and enforcing federal airport security rules and regulations. TSA also means TSA's Undersecretary or the Undersecretary's duly authorized representative(s).

TSR: an acronym for Transportation Security Regulation.

#### 1.05 PARTIAL LIST OF PHRASES

- A. Read "includes" and "including" as having the phrase "but not necessarily limited to" immediately following the words, if not otherwise written out.
- B. "Required" means products, labor and services provided by the Contractor to properly complete the Work following the Contract Documents and the design concept expressed therein, such required work being determined and governed by field or shop conditions.

#### 1.06 PARTIAL LIST OF ABBREVIATIONS AND ACRONYMS

- A. Following abbreviations and acronyms may appear on Drawings and in other Sections:
  - 1. CFP: City-furnished product(s).
  - 2. CSP: Contractor-salvaged product(s).
  - 3. NIC or N.I.C.: Not in contract.
  - 4. NOTAM: Notice to Airman.
  - 5. PDC: Department of Aviation Planning Design Construction Group.
  - 6. RFI: Request for Information/Clarification.
  - 7. RFP: Request for Proposal.
  - 8. WCD: Work Change Directive.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)



**END OF SECTION**

**SECTION 01450**  
**CONTRACTOR'S QUALITY CONTROL**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General requirements for Contractor's quality control services.
- B. Contractor's responsibilities related to City's testing are specified in Section 01455 - City's Acceptance Testing.

1.02 GENERAL

- A. Maintain source and on-site quality control over suppliers, manufacturers, products, services, site conditions, quality assurance programs, and workmanship, to provide work of required quality at no additional cost to the City.
- B. Follow manufacturers' installation instructions, including each step-in sequence.
- C. Request clarification from City Engineer before proceeding should manufacturers' instructions conflict with Contract Documents.
- D. Follow specified standards as minimum requirements for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform work by persons qualified to produce the specified level of workmanship.
- F. Observe, inspect, collect samples and test samples of the Work as it progresses and as required for compliance with Document 00700 - General Conditions Paragraph 3.2.
  - 1. At Contractor's discretion, retain a testing laboratory to supplement manufacturers' own product testing programs, except do not retain the same testing laboratory retained by City under Section 01455 - City's Acceptance Testing.
  - 2.
  - 2. Additional responsibilities of Contractor related to testing are specified in Section 01455 - City's Acceptance Testing.

1.03. CONTRACTOR'S QUALITY ASSURANCE PROGRAM (QAP)

**CONTRACTOR'S QUALITY CONTROL**

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- A. Implement and maintain a QAP of inspection, sampling, testing, and observation and test results reporting for the Work, applicable to product source, fabrication, mixing, and through final installation, to provide proper work.
  
- B. Submit required submittals and requests for information (RFIs) into the HAS's web-based application, Microsoft SharePoint. Access to the SharePoint portal and required training will be coordinated through the Project Manager. Submit Contractor's Quality Assurance Program (QAP), following Section 01340 - Shop Drawings, Product Data and Samples, with following minimum information:
  1. Organization chart indicating Contractor's QAP personnel.
  2. Inspection, Sampling and Testing Matrix/ Schedule: Overlaid with requirements of Section 01325 - Construction Schedules and Section 01455 - City's Acceptance Testing.
  3. Sample QAP reporting forms.
  4. Procedures for action to correct defective work.
  5. Procedures to implement and manage the QAP.
  6. Submit one copy of Contractor's written QAP Inspection, Test, and Daily Reports to City and one copy to ITL, on a daily basis, indicating:
    - a. Project Name, Number, CIP Number.
    - b. Date/time of inspection/sampling/test, and quantity of product involved.
    - c. Product or installation batch, mill number, or production run number, and method used to assure statistically based random sampling following ASTM D3665.
    - d. Environmental conditions where applicable to results.
    - e. Name and signature of observer or tester, certifying as follows:

"The above work was inspected/sampled and tested in the manner described, and the result(s) are hereby certified by the undersigned as complete and accurate."
    - f. Product or installation inspected, by Section number, and location of inspection (such as product source, fabrication shop, or on site), and quantity of product tested.
    - g. Location in the Work, by Drawing/detail number, floor number, range/station number, or other specific identifier traceable to the Drawings.

**CONTRACTOR'S QUALITY CONTROL**

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- h. Type of inspection or test (such as visual; non-destructive X-ray), and type of test by referenced standard test number.
  - i. Type of inspection, sample or test products used.
  - j. Performance standard required.
  - k. Factual evidence and results of inspections, measurements or tests stated as "pass" or "fail."
  - l. Factual evidence and record of observations and tests. Include nature and type of failure, and comments as applicable.
- C. Contractor's QAP Personnel for Sitework:
- 1. Quality Control Manager: Sole responsibility for management, implementation and control of the QAP; an employee of Contractor and specialist in type of applicable construction. If not an officer of firm, this person shall report to an officer.
    - a. Duties and Responsibilities: Plan, organize, staff, direct and control the QC Program; supervise QCTs (below); collate and review detail reports of QC activities for accuracy and completeness before publication, and prepare factual summary reports. The QCM may work projects other than this project, except QCM shall be present at times of sampling, testing or observation, within 2 hours of notice.
    - b. Demonstrated experience in parking garage paving construction and quality assurance compliance equivalent in scope and complexity to work of this contract, plus one of the following minimums:
      - 1) Registered civil engineer, with 1 year above experience.
      - 2) Engineer-in-Training, with 2 years above experience.
      - 3) Graduate Bachelor of Science degree in Civil Engineering, Civil Engineering Technology or Construction, with 3 years above experience.
      - 4) National Institute for Certification in Engineering Technologies (NICET), Level III, certified Construction Materials Technician, Highway Materials Technician, or Highway Construction Technician, with 4 years above experience.
      - 5) NICET-certified Civil Engineering Technician, with 5 years above experience, and approved by the City Engineer.
  - 2. Quality Control Technicians (QCT): Responsibility for processing this QC Program; report to the QCM.

**CONTRACTOR'S QUALITY CONTROL**

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- a. Duties and Responsibilities: Inspect work, collect samples, take measurements, test work, collate test and measurement data, and prepare factual, accurate and complete reports. Use as many QCTs as required. QCTs may be Contractor's employees or personnel of a qualified ITL subcontracted to the Contractor, except do not use City's ITL to fulfill Contractor's testing requirements.
  - b. Demonstrated experience in same construction as QCM, and quality assurance compliance equivalent in scope and complexity to work of this contract, plus one of the following minimums:
    - 1) Engineer or Engineering Technician, with 1 year above experience.
    - 2) NICET Level II or higher certification as Construction Materials Technician, Highway Materials Technician, or Highway Construction Technician, , with 2 years above experience.
  3. Equivalent certifications by authorities other than NICET may be substituted following Section 01630.
- D. Contractor's QAP Personnel for Buildings:
1. Quality Control Manager: Sole responsibility for management, implementation and control of the QAP; an employee of the Contractor and specialist in type of applicable construction. If not an officer of firm, this person shall report to an officer.
    - a. Duties and Responsibilities: Plan, organize, staff, direct and control the QC Program; supervise QCT staff (below); collate and review detail reports of QC activities for accuracy and completeness before publication, and prepare factual summary reports. The QCM may work projects other than this project, except QCM shall be present at times of sampling, testing or observation, within 2 hours of notice.
    - b. Demonstrated experience in building Structural construction and quality assurance compliance equivalent in scope and complexity to work of this contract, plus one of the following minimums:
      - 1) Registered structural engineer, with 1 year above experience.
      - 2) Engineer-in-Training, with 2 years above experience.
      - 3) Graduate Bachelor of Science degree in structural engineering, with 3 years above experience.
  2. Quality Control Technicians (QCT): Responsibility for processing QAP; report to the QCM.
    - a. Duties and Responsibilities: Inspect work, collect samples, take measurements, test work, collate test and measurement data, and prepare factual, accurate and complete

**CONTRACTOR'S QUALITY CONTROL**

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reports. Use as many QCTs as required. QCTs may be Contractor's employees or personnel of a qualified ITL subcontracted to the Contractor, except do not use City's ITL to fulfill Contractor's testing requirements.

- b. Engineer or Engineering Technician, with minimum 1 year demonstrated experience in same construction as QCM, and quality assurance compliance equivalent in scope and complexity to work of this contract.

1.03 REFERENCES

- A. Obtain copies of referenced standards and maintain at site when required by other Sections.

1.04 MANUFACTURER'S FIELD SERVICES

- A. When specified in other Sections or when conditions are required to maintain schedule, cost or quality control, provide services of properly qualified manufacturer's or supplier's technical representative(s) to observe field conditions, conditions of substrates and installation, quality of workmanship, startup, testing, adjusting, balancing, demonstration and City-personnel training as required.
- B. Within 14 days of observation, submit a written report to City Engineer, prepared by manufacturer's representative, documenting their observations, supplementary instructions and instructions at variance with manufacturer's written instructions, and, where applicable, recommendations for corrective action. Costs and time for corrective action is Contractor's responsibility, without increase in Contract Sum or Time.

1.05 SUBCONTRACTS

- A. Coordinate work of subcontractors. Inform subcontractors of relation of their work to that of other subcontractors and Separate Contractors and direct scheduling of work to prevent conflicts or interferences.
- B. Employ subcontractors with documented proof of proper completion of two projects during the past 3 years of work similar in scope, type and quality as that required for this contract.

1.06 EXAMINATION AND PREPARATORY WORK

- A. Carefully examine substrates whether Base Facility or provided as part of the Work before commencing work applied to or accommodated by substrates. Proceed after unsatisfactory conditions are corrected, and after substrate work is properly prepared and complete.
- B. Take field dimension and establish and maintain lines, dimensions, and benchmarks as required to control proper fabrication and installation of work.

**CONTRACTOR'S QUALITY CONTROL**

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C. Do not proceed with affected work until unsatisfactory site conditions and substrates are correct.

1. Make written notification of scope and type of corrections required of separate contracts.

D. Repair remaining substrates following Section 01731 - Cutting and Patching.

1.07 CONTRACTOR'S TESTING

A. Follow Document 00700 - General Conditions Paragraphs 3.9.2 and this Section 01450.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 INSPECTIONS BY BUILDING OFFICIALS AND OTHER AGENCIES

A. Immediately notify City Engineer of the date of inspections by governing authorities, in order for City Engineer to attend.

END OF SECTION

**SECTION 01455**  
**CITY'S ACCEPTANCE TESTING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. City will retain an Independent Testing Laboratory (ITL) for following services:
1. Collect product samples at source, site of fabrication, or project site as required by referenced test procedure, as specified herein or in other Sections.
  2. Test product samples at source, site of fabrication, project site or in ITL's laboratory as required by referenced test procedure, as specified herein or in other Sections.
  3. Inspect execution of work at source, site of fabrication, or project site, as applicable, as specified herein or in other Sections.
  4. Record and distribute observations of work during inspections, indicating "pass" or "fail."
  5. Record and distribute results of tests, indicating "pass" or "fail."
  6. ITL does not have authority to:
    - a. Release, revoke, alter, or enlarge requirements of Contract Documents.
    - b. Approve or accept work.
    - c. Assume duties of Contractor.
    - d. Stop the Work or a part thereof.

**1.02 CONTRACTOR'S RESPONSIBILITIES**

- A. Notify City Engineer, ITL and Designer minimum 24 hours prior to expected time for inspections or sample collections. Schedule ITL's, City Engineer's, and Designer's presence for timely inspections, observations, and sample collection without delay to the Work.
- B. Provide access to the Work and cooperate with ITL for inspection and sample collection.
- C. Furnish samples of manufactured products to ITL for inspection and testing.



**CITY'S ACCEPTANCE TESTING**

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- D. Provide incidental labor, products, services and facilities for sample collection and for transportation and handling of samples to ITL's vehicle or to ITL's on-site test facility.
- E. Reimburse City by Modification (Section 01255 - Modification Procedures) for costs of retesting previously "failed" work, including time expended by City's personnel related thereto.
- F. Time delays and costs resulting from ill-timed QC work are the Contractor's responsibility, without increase in Contract Time or Price.
- G. Follow Document 00700 - General Conditions Paragraph 3.2 and Section 01450- Contractor's Quality Control.
- H. Perform work following requirements of Contract Documents.
- I. Read reports of failed tests or measurements. Implement corrective actions to prevent defective work from proceeding farther.
- J. Stop affected work when corrective action fails to bring work to required standards.
- K. Remove defective work following Section 01731 and replace with proper work.
- L. Inspect, sample and test Base Facility Section 01726, as required to determine and confirm acceptability of existing construction as substrate for new construction.
- M. If Contractor employs a testing laboratory, follow ASTM D3740 and ASTM E329, plus other test standards specified in other Sections.
- N. Provide QAP following Section 01450 - Contractor's Quality Control.
- P. Contractor shall not:
  - 1. Employ for Contractor's quality assurance testing the same ITL employed by the City for this Project.
  - 2. Retain possession of ITL's samples.

1.03 SUBMITTALS BY ITL

- A. Submit 3 copies of following to City:
  - 1. Written certification of compliance with following:
    - a. ASTM D3740 - Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
    - b. ASTM E329 - Recommended Practice for Inspection and Testing Agencies for

- Concrete, Steel, and Bituminous Materials as Used in Construction.
2. Copy of latest inspection report by Materials Reference Laboratory/ National Bureau of Standards (NBS) or inspection traceable thereto, with statement of remedies of deficiencies.
  3. Invoice for retesting previously "failed" work.
- B. Submit 5 copies of following, 3 to City, 2 to Contractor. Immediately transmit "fail" reports by facsimile directly to City and to Contractor.
1. Project Name, Number, CIP Number.
  2. Identify ITL, Contractor, Subcontractor or Supplier, Section number and name, generic and manufacturer's name of product, numerical sequence when more than one inspection, sample or test of the same product is made, date and time of each inspection, sample collection or test, and applicable Drawing detail number.
  3. Date/time of inspection/sampling/test, and quantity of product involved.
  4. Product or installation batch, mill number, or production run number, and method used to assure statistically based random sampling following ASTM D3665.
  5. Environmental conditions where applicable to results.
  6. Name and signature of observer or tester, certifying as follows:  
"The above work was inspected/sampled and tested in the manner described, and the result(s) are hereby certified by the undersigned as complete and accurate."
  7. Product or installation inspected, by Section number, and location of inspection (such as product source, fabrication shop, or on site), and quantity of product tested.
  8. Location in the Work, by Drawing/detail number, floor number, range/station number, or other specific identifier traceable to the Drawings.
  9. Type of inspection or test (such as visual; non-destructive X-ray), and type of test by ASTM or other reference standard test number.
  10. Type of inspection, sample or test equipment used.
  11. Performance standard required
  12. Factual evidence and results of inspections, measurements or tests stated as "pass" or "fail."
  13. Factual evidence and record of observations and tests. Include nature and type of

failure, and comments as applicable. Furnish graphic or narrative data, or both, indicating nominal requirements and actual test values. Indicate type and numerical value of deviations from specified requirements.

14. For submittals using SI (metric) measure as the ITL's standard, include corresponding Imperial measure conversions. Follow Section 01610 - Basic Product Requirements.
- C. Print and distribute copies of records.
- D. Transmit reports within 7 days of observations, inspections or test completion, except where shorter processing time is required due to possibility of Contractor continuing installation of "failing" work.
- E. For data in the form of drawings:
1. Submit one vellum sepia or electrostatic transparency (emulsion side "up") with one diazo print to City Engineer. Submit one diazo print to Contractor.
  2. Sheet Size: 8-1/2 x 11 inches minimum; 44 x 34 inches maximum.
  3. If CADD is used, prepare documents readable, writable and printable using IBM PC-compatible hardware and software, based on AutoCAD (11 or later versions) or software translated thereto. Provide copy of AutoCAD data disks to City Engineer
  4. Prepare drawings by qualified drafters.
  5. Draw to scale, and accurately represent products.
- F. For statistical records in the form of spreadsheets or graphs:
1. Submit electrostatic prints.
  2. Sheet Size: 8-1/2 x 11 inches minimum; 11 x 17 inches maximum.
  3. Provide copy of data disks to City Engineer at completion of the Work.

## PART 2 PRODUCTS

### 2.01 SAMPLING AND TEST EQUIPMENT

- A. Provide and maintain in proper function sampling and test equipment of type and quantity required, with calibration and accuracy traceable to NBS.

## PART 3 EXECUTION

### 3.01 GENERAL PROCEDURES

- A. Follow requirements of individual Sections.
- B. Coordinate inspections, sampling and testing with construction progress and Contractor's schedule specified in Section 01325 - Construction Schedules.
- C. At least once per shift inspect mixing, fabrication and installation of soil, cementitious and petroleum-based products for proper operation or tolerances. Confirm installers and tool operators are qualified, and tools are properly functioning.
- D. Sample at frequencies following requirements of applicable Sections or as specified herein and test each sample.
- E. Take quantity, linear, volume and bulk measurements as frequently as necessary to control mixing, fabrication and installation.
- F. Properly calibrate test equipment and measuring tools before use.
- G. Immediately report failed tests or measurements.
- H. Test work for proper function and performance as specified herein and in other Sections.
- I. Test and balance final HVAC system by AABC-certified contractor as part of the Work.

#### INSPECTION AND OBSERVATION

- A. Inspect work by properly experienced personnel. Observe mixing, fabrication and installation procedures. Record observations.
- B. Inspect at frequency indicated, using visual observation and measuring tools appropriate to the work. If not otherwise required in other Sections, inspect product source at the site of origin.

#### 3.03 SAMPLING

- A. Unless otherwise indicated in Sections or otherwise required by test standard, randomly collect 3 samples and maintain possession until observation and testing is complete and results documented.
- B. Collect and handle samples following test standard.
- C. Coordinate operations with Contractor.

#### 3.04 TESTING

- A. Test products *in situ* as approved by City Engineer or in laboratory where destructive tests are required, test to product failure. Note factual observations, test results, and

measuring equipment setup, typed or legibly handwritten. For graph illustrations, use computerized database or spreadsheets.

- B. Store and cure samples following test standards or as required to maintain samples in pristine condition until tested.
- C. Test samples for conformance with requirements.
- D. Follow test standards specified herein and in other Sections.

### 3.05 SCHEDULE OF INSPECTIONS, SAMPLES AND TESTS

- A. Observe mixing, fabrication and installation, and inspect, collect samples and test, as indicated in applicable Sections.

END OF SECTION

**SECTION 01505**  
**TEMPORARY FACILITIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General temporary facilities:

1. Utilities and environmental systems.
2. Sanitary facilities.
3. Field office.
4. Storage sheds, buildings and lay-down areas.
5. General-purpose radios. ATCT radios are specified in Section 01640 - City-Furnished Products.
6. Fire protection.
7. Protection of the Work and property.
8. Interim cleaning.
9. Disposal of trash and debris.

B. Temporary facilities for exterior work:

1. Barricades.
2. Hazard lighting.
3. Access roads and parking.
4. Environmental controls.
5. Disposal of excavated material.
6. Control of erosion and water runoff.

C. Temporary facilities for interior work:

1. Barricades and enclosures, including those for accessways and exit ways.

2. Hazard lighting.
  3. Environmental controls.
  4. Existing electrical power, water, and HVAC are available at interior construction projects for Contractor's use at no charge by City Engineer.
- D. Provide temporary product handling facilities and construction aids, such as scaffolds, staging, ladders and stairs, protective railings, hoists, chutes and other facilities, as required for construction operations and to protect persons, property and products. Follow governing agency requirements for scope, type and location if not otherwise specified.
- E. Follow Section 01326 - Construction Sequencing for mobilization and demobilization requirements.
- F. Temporary facilities specified herein are minimum standards. Provide additional facilities as required for proper execution of the Work and to meet responsibilities for protection of persons and property.
- G. Properly install temporary facilities.
- H. Maintain in proper operating condition until use is no longer required or as otherwise approved.
- I. Modify and extend temporary facilities as required by Work progress.
- J. Restore existing facilities used temporarily, to specified or original condition following Section 01731 - Cutting and Patching.
- K. Provide weather protection and environmental controls as required to prevent damage to remaining Base Facility, the Work, and to other property.
- L. Follow regulatory agency requirements for required temporary facilities not specified herein.
- M. Where disposal of spoil and waste products, whether or not they are contaminated, is required under this or other Sections, make legal dispositions off site following governing authorities' requirements, unless on-site disposition is allowed under this or other Sections.
- 1.02 SUBMITTALS
- A. Follow Section 01340 - Shop Drawings, Product Data and Samples.
- B. Submit shop drawings and descriptive data showing:
1. Enclosure and barricade construction.
  2. Enclosure and barricade layout if different from that shown on Drawings, including for each stage if applicable.

- C. Submit preliminary version of ATCT and general-purpose radio procedures with list of ATCT and general-purpose radio operators, general-purpose radio call signs and frequency following SECTION 01340 - Shop Drawings, Product Data and Samples. Submit final version following Section 01312 - Coordination and Meetings.
- 1.03 GENERAL REQUIREMENTS FOR UTILITIES AND ENVIRONMENTAL SYSTEMS
- A. Make arrangements with utility service companies for temporary services.
  - B. Follow rules and regulations of utility service companies or authorities having jurisdiction.
  - C. Maintain utility service until Substantial Completion, including fuel, power, light, heat, and other utility services necessary for execution, completion, testing, and initial operation of the Work.
  - D. Follow Section 01312 - Coordination and Meetings for advance notifications and approvals of shutdowns of existing services and systems.
  - E. Water: Provide water for construction, at Contractor's sole cost and expense except as otherwise required below. Coordinate location and type of temporary water service with and obtain approval from City Engineer.
    - 1. For water obtained direct from water mains or fire hydrants, obtain permit or license from proper authorities, and install temporary meter if applicable.
    - 2. For water obtained downstream from Department of Aviation meter, City will provide water without cost for construction operations. Obtain approval of tap types, locations, and pipe routing. Provide valves and pipe as required.
    - 3. For drinking water for personnel, provide potable water in proper dispensing containers, except public drinking fountains close to interior construction projects are available as long as use by Contractor does not impede airport operations or increase airport maintenance.
  - F. Electrical Power: Provide power for lighting, operation of Contractor's plant or tools, or other uses by Contractor, at Contractor's sole cost and expense, except as otherwise required below. Coordinate location and type of temporary power service with and obtain approval from City Engineer.
    - 1. For power obtained direct from electric mains, obtain permit or license from proper authorities, and install temporary meter if applicable.
    - 2. For power obtained downstream from Department of Aviation meter, City will provide power, without cost for construction operations, however, this shall be solely at the discretion of the City Engineer. Tap existing electrical panels and circuits at locations



**TEMPORARY FACILITIES**

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- and ampacities approved by City Engineer. Obtain approval of tap types, locations, and conduit/wire routing. Provide switches as required.
3. Provide temporary power service or generators to power construction operations and to power existing facilities during main service shutdowns, and at locations where proper commercial power is not available.
- G. Lighting: Provide lighting in construction areas, or other areas used by Contractor, at Contractor's sole cost and expense, except as otherwise required below. Coordinate location and type of temporary light fixtures with and obtain approval from City Engineer.
1. Provide explosion-resistant fixtures in areas where fuel is stored, handled or dispensed.
  2. Minimum Lighting Level: 5-foot candles for open areas; 10-foot candles for exitways. Provide minimum of one 300W lamp per 20 square feet of work area.
- H. Heat and Ventilation: Provide temporary heat and ventilation as required for protection or completion of the Work and to control dust, odors and other environmental contaminants. Provide safe working conditions. Maintain enclosed work areas, including interior work areas, at minimum of 50 degrees F.

1.04 SANITARY FACILITIES

- A. Provide one portable self-contained chemical toilet/urinal for each 25 workers for exterior construction projects or construction areas not close to existing public restrooms. Place at reasonably secluded locations conveniently accessible to workers. Follow regulations of State and local departments of health.
1. Public restrooms close to interior construction projects are available as long as use by Contractor does not impede airport operations or increase airport maintenance.
- B. Enforce use of sanitary facilities.
- C. Supply and service temporary sanitary units at least twice per week. Legally dispose of waste off-site.

1.05 STORAGE SHED, BUILDINGS AND LAY-DOWN AREAS

- A. Store products neatly and orderly onsite, arranged to allow inspection, identification and inventory, at locations approved by City Engineer.
- B. When lack of or ill-timed environmental control systems could damage products, store in bonded off-site facilities approved by manufacturer, supplier or fabricator.
- C. Provide suitable and substantial storage sheds, rooms, covers, or other facilities, for storage of material subject to contamination or damage from other construction operations. Provide environmental control to maintain products within manufacturers' required limits, when

required. Storage of materials not susceptible to weather damage may be on blocks off the ground.

- D. Do not overload Base Facility structure. Provide temporary shoring or bracing as required to prevent damage to structures.

#### 1.06. GENERAL-PURPOSE RADIOS

- A. Furnish type and number of radios as required by Contractor, for the limited purpose of Contractor's internal communications, on FCC-approved frequencies provided those frequencies do not interfere with ATCT communications.
- B. Provide proper FCC licenses for operators.

#### 1.07 FIRE PROTECTION

- A. Follow fire protection and prevention requirements specified herein and those established by Federal, State, or local governmental agencies.
- B. Follow applicable provisions of NFPA Standard No. 241, Safeguarding Building Construction and Demolition Operations.
- C. Provide portable fire extinguishers, rated not less than 2A or 5B following NFPA Standard No. 10, Portable Fire Extinguishers, for field office and for every 3000 square feet of floor area of facilities under construction, located within 50 feet maximum from any point in the protection area.
- D. Prohibit smoking in hazardous areas. Post suitable warning signs in areas which are continuously or intermittently hazardous.
- E. Use metal safety containers for storage and handling of flammable and combustible liquids.
- F. Do not store flammable or combustible products inside occupied buildings or near stairways or exits.
- G. Maintain clear exits from all points in the Work.

#### 1.09 PROTECTION OF THE WORK AND PROPERTY

- A. Take precautions, provide programs, and take actions necessary to protect the Work and public and private property from damage.
- B. Prevent damage to existing public and private utilities and systems during construction. Utilities are shown on Drawings at approximate locations, but this information is not warranted as complete or accurate. Give City Engineer at least 48 hours notice before

commencing work in the area, for locating the utilities during construction, and for making adjustments or relocation of the utilities when they conflict the Work.

1. Utilize the Utility Coordinating Committee One Call System, telephone number, (713) 223-4567, called 48 hours in advance. The toll-free telephone number is 1-800-245-4545, Texas One Call System.
  2. Follow Section 01726 - Base Facility Survey, to determine existing utilities and systems.
  3. Follow Section 01761 - Protection of Existing Services, to make coordination efforts for each existing Service that requires protection.
- C. Provide safe barricades and guard rails around openings, for scaffolding, for temporary stairs and ramps, around excavations, accessways, and hazardous areas.
- D. Obtain written consent from proper parties, before entering or occupying with workers, tools, or products on privately-owned land, except on easements required by the Contract Documents.
- E. Assume full responsibility for preservation of public and private property on or adjacent to the site. If direct or indirect damage is done by or on account of any act, omission, neglect, or misconduct in execution of the Work by Contractor, restore by Contractor, at no cost or time increase, to a condition equivalent to or better than that existing before the damage was done.
- F. Where work is performed on or adjacent to roadways, rights-of-way, or public places, provide barricades, fences, lights, warning signs, and danger signals sufficient to prevent vehicles from being driven on or into Work under construction.
1. Paint barricades to be visible from sunset to sunrise
  2. Install at least one flashing hazard light at each barricade section.
  3. Furnish watchmen in sufficient numbers to protect the Work.
  4. Other measures for protection of persons or property and protection of the Work.
- G. Protect existing trees, shrubs, and plants on or adjacent to the site against unnecessary cutting, breaking or skinning of branches, bark, or roots.
1. Do not store products or park vehicles within drip lines.
  2. Install temporary fences or barricades in areas subject to damage from traffic.
  3. Water trees and plants to maintain their health during construction operations.

**TEMPORARY FACILITIES**

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4. Cover exposed roots with burlap and keep continuously wet. Cover exposed roots with earth as soon as possible. Protect root systems from physical damage and damage by erosion, flooding, run-off, or noxious materials contamination.
  5. Repair branches or trunks if damaged, prune branches immediately and protect the cut or damaged areas with emulsified asphalt compounded specifically for horticultural use in a manner approved by City Engineer.
  6. Remove and replace damaged trees and plants that die or suffer permanent injury. Replace with product of equivalent size and in good health.
  7. Coordinate this work with Division 2 requirements for clearing and landscaping.
- H. Protection of Existing Structures:
1. Fully sustain and support in place and protect from direct or indirect injury underground and surface structures located within or adjacent to the limits of the Work.
    - a. Before proceeding with sustaining and supporting work on property of others, satisfy City Engineer that the owner of the property approves the methods and procedures proposed.
  2. Do not move or in any way change the property of public utilities or private service corporations without prior written consent of a responsible official of that service or public utility. Representatives of these utilities reserve the right to enter within the limits of the Work for the purpose of maintaining their properties, or of making changes or repairs to their property considered necessary by performance of the Work.
    - a. Notify the owners and/or operators of utilities and pipelines of the nature of construction operations proposed and the date or dates on which those operations will be performed. When construction operations are required in the immediate vicinity of existing structures, pipelines, or utilities, give minimum 5 working days advance notice. Probe and securely flag locations of underground utilities prior to beginning excavation.
  3. Assume all risks attending presence or proximity of existing construction within or adjacent to the limits to the Work including but not limited to damage and expense for direct or indirect injury caused by the Work to existing construction. Immediately repair damage caused, following Section 01731.
- I. Protect installed products to prevent damage from subsequent operations. Remove protection facilities when no longer needed.
1. Control traffic to prevent damage to products and surfaces.

**TEMPORARY FACILITIES**

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2. Provide coverings to protect products from damage. Cover projections, wall corners, jambs, sills, and off-site of openings in areas used for traffic and for passage of product in subsequent work.

PART 2 PRODUCTS

2.01 GENERAL

- A. Provide products for temporary construction using equivalent type as required for permanent construction, except “construction grade” quality may be used (such as for wood framing, enclosures and barricades, and construction locks).
- B. Where materials for use in this Section are not specified or detailed, propose products in writing and obtain approval from City Engineer before commencing work.

2.02 TEMPORARY EXTERIOR ENCLOSURES AND BARRICADES

- A. Repair damaged existing barricades following Paragraph B. Reuse existing to maximum practical extent. Match new work to existing sightlines, profiles, and color
- B. Provide temporary fencing as required to enclose exterior storage/staging and demolition areas, during on-site operations, chain link fence at remote areas (away from Terminal buildings), and chain link fence with plywood overlay at on-site areas (adjacent to or near Terminal buildings and AOA).
  1. Chain Link: Minimum 6-foot high commercial quality galvanized fabric, galvanized steel or minimum 4 x 4 treated wood posts at 8 feet on center maximum, gate frames as required, with barbed wire at top if required by Contractor. For natural earth areas, provided minimum 8-inch diameter by 3-foot deep hole for posts. Fill annular space with pea gravel or crushed stone. For paved areas, provide welded base plate on each post and attach to paving with drill-in or powder actuated fasteners of size and quantity required to resist imposed loads. Provide corner bracing and struts as required to maintain erect fencing and taut fabric. Provide gate locks of Contractor's choice. Provide one set of keys to City Engineer.
  2. Plywood Overlay: Exterior grade, minimum 3/4 inch-thick, 8-feet-high. Tie plywood with wire to public side of chain link fence and gates. Paint exterior (public) face with flat latex-based paint to match “Nevamar Pepperdust” plastic laminate.
- C. Barricades in Safety Areas of Taxiways and Aprons at AOA: Preservative-treated wood construction, maximum 3 feet high sawhorse legs at both ends of one 8-inch-high top rail, with 45 degree-angled white and orange hashmarks, on 4 by 4-inch wood posts and struts bolted to 12 by 12-inch continuous timber base. Install hazard lights at maximum 6 feet centers and at each end and corners of the barricade. Sandbag wood frame to prevent overturning by jet blast or prop wash.

**TEMPORARY FACILITIES**

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- D. Barricades at Roadways and Outside Safety Areas: Standard 13 foot 6-inch-long traffic guard rail type or precast concrete “Jersey” barriers, with 1 hazard light for each section.

2.03 TEMPORARY INTERIOR ENCLOSURES AND BARRICADES

- A. Provide temporary partitions and ceilings or reuse existing partitions as required to separate work areas during on-site finishing operations, to prevent penetration of dust, odors, gases and moisture into occupied areas and to prevent damage to remaining Base Facility and to Contractor's work. Remove new and existing barricades upon completion of work or as directed by City.
- B. Rigid Barricades and Enclosures: Provide wood or metal framing and gypsum board or plywood sheet materials with closed joints; flame spread rating of 25 or less following ASTM E84.
  - 1. Paint faces exposed to public areas to match “Nevamar Pepperdust” plastic laminate, as required by City Engineer.
  - 2. Sandbag or foam-tape floor track to existing terrazzo or tile flooring. Do not fasten to existing finished walls or ceiling tiles.
- C. Membrane Enclosures: Provide same framing as above. Cover with minimum 12 mil black plastic sheet, with taped joints and edges. Seal punctures as they occur.
- D. Perimeter Tape: Manufactured plastic tape, with printed “Construction Area” or equivalent message. Fasten to saw horses, “trees” or equivalent moveable posts. Repair breaks as they occur. Install around areas where quick changeability of barrier limits is required.

2.04 HAZARD LIGHTS

- A. Provide battery-powered flashing yellow lights on barricades and enclosures around perimeter of exterior areas adjacent to AOA, roadways, and parking aisles or spaces. Install on posts set in striped barrels and anchored with sand, or attach to fencing, as applicable and as ground space permits where barricades or enclosures do not occur.

2.05 TEMPORARY UTILITY AND ENVIRONMENTAL SYSTEMS WORK

- A. Furnish temporary HVAC, plumbing and electrical products as required to provide continued Base Facility operation, including systems by-pass dampers, ductwork, valves, pipe and fittings, conduit, wiring, junction boxes, and other items.
- B. Coordinate these products with products of Sections 01731 - Cutting and Patching and Divisions 2, 15 and 16.

PART 3 EXECUTION

3.01 CONTRACTOR'S FIELD OFFICE

- A. Install field office ready for occupancy, 10 days after date fixed in Notice to Proceed.

### 3.02 ENCLOSURE AND BARRICADE, SIGN, AND HAZARD LIGHT INSTALLATION

- A. Fill and grade site for temporary structures to provide drainage away from buildings. Follow Section 01506- Temporary Controls and 01572 - Erosion and Sedimentation Control for erosion and sedimentation control.
- B. Follow Section 01507 - Temporary Signs.
- C. Install and maintain enclosures and barricades, passageways, signs and lights at locations shown on Drawings, or as directed by City Engineer, or as required to safely divert unauthorized parties away from or around construction operations.
  - 1. Maintain minimum 3-foot candles of illumination at exitways, including those remaining adjacent to permanent barricades.
  - 2. Reinforce barricades at AOA as required to withstand jet blast loads.

### 3.03 TEMPORARY UTILITY AND ENVIRONMENTAL SYSTEMS

- A. Install temporary HVAC, plumbing and electrical products as required to maintain adequate environmental conditions to facilitate progress of Work, to meet specified minimum conditions for installation of materials, to protect materials and finishes from damage due to temperature or humidity beyond specified or otherwise required ranges, and to maintain proper Base Facility systems operation outside contract limits.
- B. Provide ventilation of enclosed areas for proper curing of installed products, to disperse or control humidity, and to prevent hazardous accumulations of dust, fumes, vapors or gases inside or outside of enclosures.

### 3.04 CONSTRUCTION EQUIPMENT

- A. See Document 00646 - Affidavit for FAA Form 7460-1 for filing of information related to height of construction equipment. When not in use, store equipment in designated location outside safety areas.

### 3.06 REMOVAL OF TEMPORARY FACILITIES

- A. Maintain temporary facilities until Substantial Completion inspection, or when use is no longer required, or as directed by City Engineer.
- B. Clean and repair damage caused by installation or use of temporary facilities.
- C. Restore existing facilities used during construction to specified or original condition following Section 01731 - Cutting and Patching.

3.07 DISPOSAL OF DEBRIS, EXCESS PRODUCTS AND EXCAVATED MATERIAL

- A. Legally dispose of waste and excess products off site. Do not burn or bury on site.
  - 1. Prepare and file with Texas Department of Health (TDH) "TDH Demolition/ Renovation Notification" related to compliance with National Emissions Standards for Hazardous Air Pollutants. Obtain form from TDH, 10500 Forum Place Drive, Suite 300, Houston, TX 77036-8599, (713) 414-6125, or (800) 572-5548.
- B. Place excavation material and salvageable products on site at locations and to profiles shown on Drawings or as directed by City Engineer.
  - 1. Load, haul, and deposit excavated material.
  - 2. Base, surface, and bedding material: Load shell, gravel, bituminous, or other base and surfacing material into City of Houston trucks.
  - 3. Other salvageable materials: Follow individual Sections.
  - 5. Coordinate loading of salvageable material on City's trucks with City Engineer.

3.08 INTERIM CLEANING

- A. Temporarily store debris in areas concealed from public, occupants' and AOA view. Prevent migration of debris and dust following Section 01506 - Temporary Controls.
- B. Clean-up dirt and debris in vicinity of construction entrances each day. Clean up debris, scrap materials, and other disposable items before completion of each day's work. Keep streets, driveways, and sidewalks clean of dirt, debris and scrap materials.
  - 1. Failure to maintain clean site is the basis for City Engineer take action following Section 2.5 in Document 00700 - General Conditions.
- C. Remove debris daily unless otherwise approved by City Engineer.
- D. Prevent hazardous conditions due to product or debris storage in work areas and storage areas.
- E. Keep streets used for entering or leaving the job area free of excavated material, debris, and foreign material, including carryout dust and mud, resulting from construction operations. Follow Section 01575 - Stabilized Construction Exit for vehicle wash areas. Follow City of Houston Ordinance No. 5705, Construction or Demolishing Privileges.
- F. As frequently as necessary, sweep and damp mop floors of spaces in public spaces adjoining access points through barricades or enclosures.

3.09 ACCESS THROUGH JETWAYS OR EXTERIOR WALL



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**TEMPORARY FACILITIES**

- A. Obtain City Engineer's approval to use City-owned jetways for bringing material into and out of flight station areas. Do not use privately owned or leased jetways.
- B. Where approved by City Engineer, remove and salvage curtainwall glazing at one light, provide temporary enclosure and building protection, and reinstall salvaged products upon completion of required accessibility.

END OF SECTION

**SECTION 01506**  
**AIRPORT TEMPORARY CONTROLS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Dust control.
- B. Noise control.
- C. Pest and rodent control.
- D. Pollution and environmental control.
- E. Security controls, security plan and procedures. Work in AOA or the airport's secured area is not intended as part of this Contract; however, TSA may be involved in reviews of Contractor's construction plans to verify no TSA requirements or restrictions apply.
- F. Safety requirements and safety plan.
- G. Emergency procedures.

1.02 REFERENCES

- A. U.S. Department of Transportation Federal Aviation Administration Advisory Circular AC 150/5370-2C.

1.03 SUBMITTALS

- A. Make following submittals in 3-ring "D" binders, with clear spine and cover pockets and label "Airport Construction Control Plans" on white card-stock inserts. Prepare submittals as work of this and other Sections but submit following Section 01312 - Coordination and Meetings.
- B. Preliminary "Airport Construction Control Plans": Submit, under provisions of Section 01325, 3 copies in draft form of the following, with section dividers labeled as and containing:
  - 1. Construction Traffic Control Plan prepared under Section 01555 - Traffic Control and Regulation.
  - 2. Emergency Response Plan Listing Safety Officers (Paragraph 1.09) with names, positions, office and home telephone numbers, and pager and portable telephone numbers.

**AIRPORT TEMPORARY CONTROLS**

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3. Safety Plan, including Trench Safety Plan prepared under Section 01561 - Trench Safety System.
  4. Security Plan.
  5. Dust Control Plan.
  6. Ground Water and Surface Water Control Plan prepared under Section 01578 - Control of Ground and Surface Water.
  7. Revise as required and submit 5 final copies, in same form as preliminary copies under Section 01312 - Coordination and Meetings.
- C. Pesticides and Poisons: Submit following Section 01340 - Shop Drawings, Product Data and Samples. Include Material Safety Data Sheets and manufacturers' recommendations for use and application. Include copy of applicator's certification from manufacturer.
- 1.04 DUST CONTROL
- A. Prevent uncontrolled dust creation and movement. Prevent airborne particulates from reaching receiving streams or storm water conveyance systems, building interiors and AOA.
  - B. Use spray-on adhesives or plastic covers on exposed soil piles.
  - C. Follow Section 01505 - Temporary Facilities for interior enclosures.
  - D. Implement dust control methods immediately whenever dust migration is observed.
- 1.05 NOISE CONTROL
- A. Provide vehicles and tools with noise suppressors and use methods and products that minimize noise to the greatest degree practicable. Follow OSHA standards and City Ordinances regarding noise. Do not create noise levels which interfere with the Work, with work by City, with airport operations, or which create a nuisance in surrounding areas.
  - B. Do not use impact-type or powder-actuated-type tools adjacent to occupied office-type areas.
- 1.06 PEST AND RODENT CONTROL
- A. Provide pest and rodent control as required to prevent infestation of construction or storage areas using legal chemicals applied by a licensed applicator.
  - B. Provide methods and products with no adverse effect on the Work or adjoining properties.
  - C. Use and store chemicals following manufacturers' recommendations and with local, state, and federal regulations. Avoid overuse of pesticides that produce contaminated runoff.

**AIRPORT TEMPORARY CONTROLS**

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Prevent spillage. Do not wash pesticide containers in or near flowing streams or storm water conveyance systems, or inside buildings.

1.07 POLLUTION AND ENVIRONMENTAL CONTROL

- A. Prevent contamination of soil, water or atmosphere by discharge of noxious substances from construction operations.
- B. Contain spillage and remove contaminated soils or liquids. Excavate and dispose of contaminated earth off-site and replace with suitable compacted fill and topsoil.
- C. Prevent harmful substances from entering public waters. Prevent disposal of wastes, effluents, chemicals, or other such substances adjacent to streams, or in sanitary or storm sewers.
- D. Provide systems for control of atmospheric pollutants. Prevent toxic concentrations of chemicals. Prevent harmful dispersal of pollutants into the atmosphere.
- E. Use equipment during construction following Federal, State, and local laws and regulations.
- F. Follow statutes, regulations, and ordinances governing prevention of environmental pollution and preservation of natural resources, including but not limited to the National Environmental Policy Act of 1969, PL 91-190, Executive Order 11514.
- G. Undeveloped areas on the airport site have considerable natural value. Do not cause unnecessary excavation or filling of terrain, unauthorized destruction of vegetation, air or stream pollution, nor harassment or destruction of wildlife.
- H. Follow environmental requirements. Limit disturbed areas to boundaries established by the Contract Documents. Do not pollute on-site streams, sewers, wells, or other water sources.

1.08 SECURITY CONTROLS, PLAN AND PROCEDURES

- A. Protect products and property from loss, theft, damage, and vandalism. Protect City property and other private property from injury or loss in connection with the Work.
- B. Employ watchmen as needed to provide required security and prevent unauthorized entry.
- C. Repair damage or replace property vandalized.
- D. If existing fencing or barriers are breached or removed for purposes of construction, provide an appropriate (as determined by the airport manager or designee) number of guards and/or maintain temporary security fencing equivalent to existing and approved by City Engineer.

**AIRPORT TEMPORARY CONTROLS**

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- E. Maintain security program through construction until City's acceptance and occupancy precludes need for Contractor's security program.
- F. Provide chain link fence Terminal area staging areas, following Section 01505 - Temporary Facilities.
- G. Airport Security Requirements:
  - 1. Airport Manager and TSA monitor effectiveness of airport security by attempting to gain unauthorized entry into security areas. When TSA gains unchallenged access to security areas, City and/or the responsible individual may be fined. When unauthorized entry into security areas is made through contract limits or other areas under the Contractor's control:
    - a. Reimburse the City, without increase in contract price, the amount of imposed fines levied against the City, accomplished by Change Order following Section 01255 - Modification Procedures.
    - b. Cease work in breached areas until proper security measures are in place, without change in contract price or time.
  - 2. Immediately notify HPD of discovered presence of unbadged or unknown persons, vehicles or animals in security areas. Dial (IAH) (281) 231-3100.
  - 3. Obtain permitted AOA gate and other security area access locations from Airport Manager. Assign personnel to control passage through entry points not staffed by airport personnel.
  - 4. Badges:
    - a. *After contract award and before preparation of the Safety Plan (Paragraph 1.09D) and construction schedule (Section 01325), obtain permitted security badges.*
    - b. *Security identification badges are required for access into AOA/Secured areas. Badges are valid for one year or for the period of the contract, whichever is shorter.*
    - c. *TSA TSR Part 1542.209 applies to personnel engaged in work of this contract occurring within the AOA or secured area, and reads in part as follows:*  
  
*"...each airport operator must ensure that no individual is granted unescorted access authority unless the individual has undergone a fingerprint-based criminal history records check (CHRC) that does not disclose that he or she has a disqualifying criminal offense."*

**AIRPORT TEMPORARY CONTROLS**

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- d. Obtain from City Engineer and fill out one security badge application package (application form and all associated paperwork) per person (including subcontractors' personnel) needing unescorted access in security areas.*
  - e. Contact the airport ID badging office to arrange for collection and submittal of fingerprints. Prepare and maintain a file for each applicant, including a copy of the completed application. Keep in Contractor's main office until expiration of the warranty period.*
    - (1) Short-term or temporary personnel are permitted in security areas but only under constant escort by a properly badged escort, who shall have no duty other than to escort short-term or temporary personnel.*
    - (2) Badged and escorted personnel are limited to access to and from work areas and shall remain in the work area.*
    - (3) Personnel under constant escort shall be continuously observed by and in the immediate company of badged personnel.*
    - (4) City Engineer may limit the number of badged personnel and personnel under constant escort.*
  - f. Submit completed applications to City Engineer for further review.
  - g. Attend required security training sessions.
  - h. Pick up completed badges and pay badging fees (as of November 2019, \$55.00 per badge for a 1-year period--verify fee and duration with Airport Manager).
5. Do not leave fence breaks unattended. Restore fence or erect equivalent secure temporary fencing before departing the work area.
6. Provide proper identification on Contractor's vehicles permitted in AOA.

1.09 SAFETY REQUIREMENTS

- A. Contractor and not City, City Engineer or Designer is solely and without qualification responsible for observation and compliance with safety regulations without reliance or superintendence of or direction by City, City Engineer or Designer.
- B. Safety measures, including but not limited to safety of personnel, provision of first-aid equipment, installation, operation and removal of temporary ventilation and safety equipment, in the Contract Documents are a subsidiary obligation of Contractor compensated through various payment items.
- C. Follow Document 00700 - General Conditions Paragraph 10.1 and this Section for safety plan and procedures.

**AIRPORT TEMPORARY CONTROLS**

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- D. Prepare a written detailed Safety Plan for the Work describing:
1. Specific methods used to maintain airport safety procedures, based on requirements of the Contract Documents, airport procedures, FAA/TSA requirements and Contractor's own safety and security program.
  2. Contractor's emergency procedures in event of following minimum set of circumstances: airport's-, tenants'- or Contractor's on-site property damage; accidents; fire emergency; medical emergency; Airport Manager's intervention in construction operations; detainment or arrest of unauthorized Contractor's employees and subcontractors in Security areas; discovery of hazardous materials.
  3. Provisions for temporary removal of security fencing (including culvert and drain-way grates). Include proposed actions to prevent entry of people or animals into security areas when security fence is breached. Do not breach fencing without approval.
  4. Requirements for closing safety areas.
  5. Submit draft Safety Plan at the Preconstruction Conference, following Section 01312 - Coordination and Meetings.
- E. City Engineer will review the safety program with FAA and ATCT for compliance with applicable regulations. If the plan fails to demonstrate compliance, modify it until approval is obtained.
- F. Contractor's Safety Officers: Refer to Section 01550 - Public Safety & Contractor Safety Staffing, Paragraph 1.05, Contractor's Safety Staffing Requirements.
- G. Submit final Safety Plan at the first Progress Meeting following Section 01312 - Coordination and Meetings.
1. Include in the safety plan Contractor's response to trench safety requirements following Section 01561 - Trench Safety System.
- H. Follow applicable Federal, State and local safety codes and statutes and with proper construction practice. Establish and maintain procedures for safety of work, personnel and products involved in the Work.
- I. Follow Texas Occupational Safety Act (Art. 5182a, V.C.S.) and promulgations of Secretary of Labor under Section 107 of Contract Work Hours and Standards Act, published in 29 CFR Part 1926 and adopted by Secretary of Labor as occupational safety and health standards under the Williams-Steiger Occupational Safety and Health Act of 1970. Follow other legislation enacted for safety and health of Contractor employees. These safety and health standards apply to Contractor, Subcontractors and Suppliers and their respective employees.

**AIRPORT TEMPORARY CONTROLS**

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- J. Immediately notify City Engineer of investigation or inspection by Federal Safety and Health inspectors of the Work or place of work on the job site, and after such investigation or inspection inform City Engineer of results. Submit 1 copy of accident reports to City Engineer within 10 days of date of inspection.
- K. Protect areas occupied by workmen by the best available devices for detection of lethal and combustible gases. Frequently test devices to assure their functional capability. Monitor liquids and gases infiltrating into work areas for visual or odor evidences of contamination. Take immediate appropriate steps to seal off entry of contaminants into to the Work.
- L. Maintain coordination with City's Police and Fire Departments during the Work.

1.10 EMERGENCY PROCEDURES

- A. If an emergency situation occurs, including involvement in or witness to aircraft or motor vehicle emergencies and emergencies involving other parties or property regardless of fault, or a violation of requirements of this Section, or a violation of FAA/TSA regulations, take one or more of the following minimum actions as appropriate to the situation.
- B. Immediately report to City Engineer accident or damage to pavement, buildings, utilities, and vehicles involving or caused by Contractor, Subcontractors, Suppliers, personnel, equipment or others.
- C. In general:
  - 1. Immediately notify HFD or HPD (public areas) as appropriate and applicable to location of emergency.
  - 2. Notify City Engineer by telephone or in person.
  - 3. Stop work in the area. Secure site as required to prevent further damage to property and persons.
  - 4. Evacuate non-essential personnel from the scene. Keep involved personnel and witnesses on-site until otherwise directed by City Engineer or security officers.
  - 5. Impound involved vehicles in "as-is condition" until otherwise directed.
  - 6. Do not resume work in the area until released by City Engineer.
- D. For discovery of actual or suspected hazardous material contamination, proceed with Paragraph B above while simultaneously initiating Contractor's own hazardous material response program.
- E. Follow City Engineer's instructions for emergencies affecting the Work but occurring outside the Contract Limits. Certain situations may require the Work or work to be temporarily stopped under provisions of Document 00700 - General Conditions.



**AIRPORT TEMPORARY CONTROLS**

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1. Maintain a log documenting cost and time impact of the stop-work order.
2. Submit data to the City Engineer in form as instructed at that time.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**ATTACHMENT 1**

TCEQ Office Use Only  
 Permit No:  
 CN:  
 RN:



**Notice of Intent (NOI) for an Authorization for Stormwater Discharges Associated with Construction Activity under TPDES General Permit TXR150000**

**IMPORTANT INFORMATION**

Please read and use the General Information and Instructions prior to filling out each question in the NOI form.

Use the NOI Checklist to ensure all required information is completed correctly.  
**Incomplete applications delay approval or result in automatic denial.**

Once processed your permit authorization can be viewed by entering the following link into your internet browser: [http://www2.tceq.texas.gov/wq\\_dpa/index.cfm](http://www2.tceq.texas.gov/wq_dpa/index.cfm) or you can contact TCEQ Stormwater Processing Center at 512-239-3700.

**ePERMITS**

**Effective September 1, 2018, this paper form must be submitted to TCEQ with a completed electronic reporting waiver form (TCEQ-20754).**

To submit an NOI electronically, enter the following web address into your internet browser and follow the instructions: <https://www3.tceq.texas.gov/steers/index.cfm>

**APPLICATION FEE AND PAYMENT**

The application fee for submitting a paper NOI is \$325. The application fee for electronic submittal of a NOI through the TCEQ ePermits system (STEERS) is \$225.

Payment of the application fee can be submitted by mail or through the TCEQ ePay system. The payment and the NOI must be mailed to separate addresses. To access the TCEQ ePay system enter the following web address into your internet browser: <http://www.tceq.texas.gov/epay>.

Provide your payment information for verification of payment:

- If payment was mailed to TCEQ, provide the following:
  - Check/Money Order Number: [REDACTED]
  - Name printed on Check: [REDACTED]
- If payment was made via ePay, provide the following:
  - Voucher Number: [REDACTED]
  - A copy of the payment voucher is attached to this paper NOI form.

**RENEWAL** (This portion of the NOI is not applicable after June 3, 2018)

Is this NOI for a renewal of an existing authorization?  Yes  No

If Yes, provide the authorization number here: TXR15 [redacted]

NOTE: If an authorization number is not provided, a new number will be assigned.

**SECTION 1. OPERATOR (APPLICANT)**

a) If the applicant is currently a customer with TCEQ, what is the Customer Number (CN) issued to this entity? CN [redacted]

(Refer to Section 1.a) of the Instructions)

b) What is the Legal Name of the entity (applicant) applying for this permit? (The legal name must be spelled exactly as filed with the Texas Secretary of State, County, or in the legal document forming the entity.)

[redacted]

c) What is the contact information for the Operator (Responsible Authority)?

Prefix (Mr. Ms. Miss): [redacted]

First and Last Name: [redacted] Suffix: [redacted]

Title: [redacted] Credentials: [redacted]

Phone Number: [redacted] Fax Number: [redacted]

E-mail: [redacted]

Mailing Address: [redacted]

City, State, and Zip Code: [redacted]

Mailing Information if outside USA:

Territory: [redacted]

Country Code: [redacted] Postal Code: [redacted]

d) Indicate the type of customer:

- Individual
- Limited Partnership
- General Partnership
- Trust
- Sole Proprietorship (D.B.A.)
- Corporation
- Estate
- Federal Government
- County Government
- State Government
- City Government
- Other Government
- Other: [redacted]

e) Is the applicant an independent operator?  Yes  No

(If a governmental entity, a subsidiary, or part of a larger corporation, check No.)

f) Number of Employees. Select the range applicable to your company.

0-20

251-500

21-100

501 or higher

101-250

g) Customer Business Tax and Filing Numbers: (**Required** for Corporations and Limited Partnerships. **Not Required** for Individuals, Government, or Sole Proprietors.)

State Franchise Tax ID Number:

Federal Tax ID:

Texas Secretary of State Charter (filing) Number:

DUNS Number (if known):

## SECTION 2. APPLICATION CONTACT

Is the application contact the same as the applicant identified above?

Yes, go to Section 3

No, complete this section

Prefix (Mr. Ms. Miss):

First and Last Name:  Suffix:

Title:  Credential:

Organization Name:

Phone Number:  Fax Number:

E-mail:

Mailing Address:

Internal Routing (Mail Code, Etc.):

City, State, and Zip Code:

Mailing information if outside USA:

Territory:

Country Code:  Postal Code:

## SECTION 3. REGULATED ENTITY (RE) INFORMATION ON PROJECT OR SITE

a) If this is an existing permitted site, what is the Regulated Entity Number (RN) issued to this site? RN

(Refer to Section 3.a) of the Instructions)

- b) Name of project or site (the name known by the community where it's located): [REDACTED]
- c) In your own words, briefly describe the type of construction occurring at the regulated site (residential, industrial, commercial, or other): [REDACTED]
- d) County or Counties (if located in more than one): [REDACTED]
- e) Latitude: [REDACTED] Longitude: [REDACTED]
- f) Site Address/Location

If the site has a physical address such as 12100 Park 35 Circle, Austin, TX 78753, complete *Section A*.

If the site does not have a physical address, provide a location description in *Section B*.  
 Example: located on the north side of FM 123, 2 miles west of the intersection of FM 123 and Highway 1.

*Section A:*

Street Number and Name: [REDACTED]

City, State, and Zip Code: [REDACTED]

*Section B:*

Location Description: [REDACTED]

City (or city nearest to) where the site is located: [REDACTED]

Zip Code where the site is located: [REDACTED]

**SECTION 4. GENERAL CHARACTERISTICS**

- a) Is the project or site located on Indian Country Lands?
  - Yes, do not submit this form. You must obtain authorization through EPA Region 6.
  - No
- b) Is your construction activity associated with a facility that, when completed, would be associated with the exploration, development, or production of oil or gas or geothermal resources?
  - Yes. Note: The construction stormwater runoff may be under jurisdiction of the Railroad Commission of Texas and may need to obtain authorization through EPA Region 6.
  - No
- c) What is the Primary Standard Industrial Classification (SIC) Code that best describes the construction activity being conducted at the site? [REDACTED]
- d) What is the Secondary SIC Code(s), if applicable? [REDACTED]
- e) What is the total number of acres to be disturbed? [REDACTED]
- f) Is the project part of a larger common plan of development or sale?

Yes

No. The total number of acres disturbed, provided in e) above, must be 5 or more. If the total number of acres disturbed is less than 5, do not submit this form. See the requirements in the general permit for small construction sites.

g) What is the estimated start date of the project? [REDACTED]

h) What is the estimated end date of the project? [REDACTED]

i) Will concrete truck washout be performed at the site?  Yes  No

j) What is the name of the first water body(ies) to receive the stormwater runoff or potential runoff from the site? [REDACTED]

k) What is the segment number(s) of the classified water body(ies) that the discharge will eventually reach? [REDACTED]

l) Is the discharge into a Municipal Separate Storm Sewer System (MS4)?

Yes  No

If Yes, provide the name of the MS4 operator: [REDACTED]

Note: The general permit requires you to send a copy of this NOI form to the MS4 operator.

m) Is the discharge or potential discharge from the site within the Recharge Zone, Contributing Zone, or Contributing Zone within the Transition Zone of the Edwards Aquifer, as defined in 30 TAC Chapter 213?

Yes, complete the certification below.

No, go to Section 5

I certify that the copy of the TCEQ-approved Plan required by the Edwards Aquifer Rule (30 TAC Chapter 213) that is included or referenced in the Stormwater Pollution Prevention Plan will be implemented.  Yes

## SECTION 5. NOI CERTIFICATION

a) I certify that I have obtained a copy and understand the terms and conditions of the Construction General Permit (TXR150000).  Yes

b) I certify that the full legal name of the entity applying for this permit has been provided and is legally authorized to do business in Texas.  Yes

c) I understand that a Notice of Termination (NOT) must be submitted when this authorization is no longer needed.  Yes

d) I certify that a Stormwater Pollution Prevention Plan has been developed, will be implemented prior to construction and to the best of my knowledge and belief is compliant with any applicable local sediment and erosion control plans, as required in the Construction General Permit (TXR150000).  Yes

Note: For multiple operators who prepare a shared SWP3, the confirmation of an operator may be limited to its obligations under the SWP3, provided all obligations are confirmed by at least one operator.

**SECTION 6. APPLICANT CERTIFICATION SIGNATURE**

Operator Signatory Name: [REDACTED]

Operator Signatory Title: [REDACTED]

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

I further certify that I am authorized under 30 Texas Administrative Code §305.44 to sign and submit this document, and can provide documentation in proof of such authorization upon request.

Signature (use blue ink): \_\_\_\_\_ Date: \_\_\_\_\_

# NOTICE OF INTENT CHECKLIST (TXR150000)

Did you complete everything? Use this checklist to be sure!

Are you ready to mail your form to TCEQ? Go to the General Information Section of the Instructions for mailing addresses.

Confirm each item (or applicable item) in this form is complete. This checklist is for use by the applicant to ensure a complete application is being submitted. **Missing information may result in denial of coverage under the general permit.** (See NOI process description in the General Information and Instructions.)

## APPLICATION FEE

If paying by check:

- Check was mailed **separately** to the TCEQs Cashier's Office. (See Instructions for Cashier's address and Application address.)
- Check number and name on check is provided in this application.

If using ePay:

- The voucher number is provided in this application and a copy of the voucher is attached.

## RENEWAL

- If this application is for renewal of an existing authorization, the authorization number is provided.

## OPERATOR INFORMATION

- Customer Number (CN) issued by TCEQ Central Registry
- Legal name as filed to do business in Texas. (Call TX SOS 512-463-5555 to verify.)
- Name and title of responsible authority signing the application.
- Phone number and e-mail address
- Mailing address is complete & verifiable with USPS. [www.usps.com](http://www.usps.com)
- Type of operator (entity type). Is applicant an independent operator?
- Number of employees.
- For corporations or limited partnerships - Tax ID and SOS filing numbers.
- Application contact and address is complete & verifiable with USPS. <http://www.usps.com>

## REGULATED ENTITY (RE) INFORMATION ON PROJECT OR SITE

- Regulated Entity Number (RN) (if site is already regulated by TCEQ)
- Site/project name and construction activity description
- County
- Latitude and longitude <http://www.tceq.texas.gov/gis/sqmaview.html>



- Site Address/Location. Do not use a rural route or post office box.

#### **GENERAL CHARACTERISTICS**

- Indian Country Lands -the facility is not on Indian Country Lands.
- Construction activity related to facility associated to oil, gas, or geothermal resources
- Primary SIC Code that best describes the construction activity being conducted at the site.  
[www.osha.gov/oshstats/sicser.html](http://www.osha.gov/oshstats/sicser.html)
- Estimated starting and ending dates of the project.
- Confirmation of concrete truck washout.
- Acres disturbed is provided and qualifies for coverage through a NOI.
- Common plan of development or sale.
- Receiving water body or water bodies.
- Segment number or numbers.
- MS4 operator.
- Edwards Aquifer rule.

#### **CERTIFICATION**

- Certification statements have been checked indicating Yes.
- Signature meets 30 Texas Administrative Code (TAC) §305.44 and is original.

# Instructions for Notice of Intent (NOI) for Stormwater Discharges Associated with Construction Activity under TPDES General Permit (TXR150000)

## GENERAL INFORMATION

### Where to Send the Notice of Intent (NOI):

By Regular Mail:

TCEQ

Stormwater Processing Center (MC228)

P.O. Box 13087

Austin, Texas 78711-3087

By Overnight or Express Mail:

TCEQ

Stormwater Processing Center (MC228)

12100 Park 35 Circle

Austin, TX

### Application Fee:

The application fee of \$325 is required to be paid at the time the NOI is submitted. Failure to submit payment at the time the application is filed will cause delays in acknowledgment or denial of coverage under the general permit. Payment of the fee may be made by check or money order, payable to TCEQ, or through EPAY (electronic payment through the web).

### Mailed Payments:

Use the attached General Permit Payment Submittal Form. The application fee is submitted to a different address than the NOI. Read the General Permit Payment Submittal Form for further instructions, including the address to send the payment.

**ePAY Electronic Payment:** <http://www.tceq.texas.gov/epay>

When making the payment you must select Water Quality, and then select the fee category "General Permit Construction Storm Water Discharge NOI Application". You must include a copy of the payment voucher with your NOI. Your NOI will not be considered complete without the payment voucher.

### TCEQ Contact List:

Application – status and form questions:

512-239-3700, [swpermit@tceq.texas.gov](mailto:swpermit@tceq.texas.gov)

Technical questions:

512-239-4671, [swgp@tceq.texas.gov](mailto:swgp@tceq.texas.gov)

Environmental Law Division:

512-239-0600

Records Management - obtain copies of forms:

512-239-0900

Reports from databases (as available):

512-239-DATA (3282)

Cashier's office:

512-239-0357 or 512-239-0187

### Notice of Intent Process:

When your NOI is received by the program, the form will be processed as follows:

- **Administrative Review:** Each item on the form will be reviewed for a complete response. In addition, the operator's legal name must be verified with Texas Secretary of State as valid and active (if applicable). The address(es) on the form must be verified with the US Postal service as receiving regular mail delivery. Do not give an overnight/express mailing address.

- **Notice of Deficiency:** If an item is incomplete or not verifiable as indicated above, a notice of deficiency (NOD) will be mailed to the operator. The operator will have 30 days to respond to the NOD. The response will be reviewed for completeness.
- **Acknowledgment of Coverage:** An Acknowledgment Certificate will be mailed to the operator. This certificate acknowledges coverage under the general permit.

or

**Denial of Coverage:** If the operator fails to respond to the NOD or the response is inadequate, coverage under the general permit may be denied. If coverage is denied, the operator will be notified.

### General Permit (Your Permit)

For NOIs submitted **electronically** through ePermits, provisional coverage under the general permit begins immediately following confirmation of receipt of the NOI form by the TCEQ.

For **paper** NOIs, provisional coverage under the general permit begins **7 days after a completed NOI is postmarked for delivery** to the TCEQ.

You should have a copy of your general permit when submitting your application. You may view and print your permit for which you are seeking coverage, on the TCEQ web site <http://www.tceq.texas.gov>. Search using keyword TXR150000.

### Change in Operator

An authorization under the general permit is not transferable. If the operator of the regulated project or site changes, the present permittee must submit a Notice of Termination and the new operator must submit a Notice of Intent. The NOT and NOI must be submitted no later than 10 days prior to the change in Operator status.

### TCEQ Central Registry Core Data Form

The Core Data Form has been incorporated into this form. Do not send a Core Data Form to TCEQ. After final acknowledgment of coverage under the general permit, the program will assign a Customer Number and Regulated Entity Number, if one has not already been assigned to this customer or site.

For existing customers and sites, you can find the Customer Number and Regulated Entity Number by entering the following web address into your internet browser: <http://www15.tceq.texas.gov/crpub/> or you can contact the TCEQ Stormwater Processing Center at 512-239-3700 for assistance. On the website, you can search by your permit number, the Regulated Entity (RN) number, or the Customer Number (CN). If you do not know these numbers, you can select "Advanced Search" to search by permittee name, site address, etc.

The Customer (Permittee) is responsible for providing consistent information to the TCEQ, and for updating all CN and RN data for all authorizations as changes occur. For this permit, a Notice of Change form must be submitted to the program area.

## INSTRUCTIONS FOR FILLING OUT THE NOI FORM

**Renewal of General Permit.** Dischargers holding active authorizations under the expired General Permit are required to submit a NOI to continue coverage. The existing permit number is required. If the permit number is not provided or has been terminated, expired, or denied, a new permit number will be issued.

### Section 1. OPERATOR (APPLICANT)

#### a) Customer Number (CN)

TCEQ's Central Registry will assign each customer a number that begins with CN, followed by nine digits. **This is not a permit number, registration number, or license number.**

If the applicant is an existing TCEQ customer, the Customer Number is available at the following website: <http://www15.tceq.texas.gov/crpub/>. If the applicant is not an existing TCEQ customer, leave the space for CN blank.

#### b) Legal Name of Applicant

Provide the current legal name of the applicant. The name must be provided exactly as filed with the Texas Secretary of State (SOS), or on other legal documents forming the entity, as filed in the county. You may contact the SOS at 512-463-5555, for more information related to filing in Texas. If filed in the county, provide a copy of the legal documents showing the legal name.

#### c) Contact Information for the Applicant (Responsible Authority)

Provide information for the person signing the application in the Certification section. This person is also referred to as the Responsible Authority.

Provide a complete mailing address for receiving mail from the TCEQ. The mailing address must be recognized by the US Postal Service. You may verify the address on the following website: <https://tools.usps.com/go/ZipLookupAction!input.action>.

The phone number should provide contact to the applicant.

The fax number and e-mail address are optional and should correspond to the applicant.

#### d) Type of Customer (Entity Type)

Check only one box that identifies the type of entity. Use the descriptions below to identify the appropriate entity type. Note that the selected entity type also indicates the name that must be provided as an applicant for an authorization.

##### **Individual**

An individual is a customer who has not established a business, but conducts an activity that needs to be regulated by the TCEQ.

##### **Partnership**

A customer that is established as a partnership as defined by the Texas Secretary of State Office (TX SOS). If the customer is a 'General Partnership' or 'Joint Venture' filed in the county (not filed with TX SOS), the legal name of each partner forming the 'General Partnership' or 'Joint Venture' must be provided. Each 'legal entity' must apply as a co-applicant.

### **Trust or Estate**

A trust and an estate are fiduciary relationships governing the trustee/executor with respect to the trust/estate property.

### **Sole Proprietorship (DBA)**

A sole proprietorship is a customer that is owned by only one person and has not been incorporated. This business may:

1. be under the person's name
2. have its own name (doing business as or DBA)
3. have any number of employees.

If the customer is a Sole Proprietorship or DBA, the 'legal name' of the individual business 'owner' must be provided. The DBA name is not recognized as the 'legal name' of the entity. The DBA name may be used for the site name (regulated entity).

### **Corporation**

A customer that meets all of these conditions:

1. is a legally incorporated entity under the laws of any state or country
2. is recognized as a corporation by the Texas Secretary of State
3. has proper operating authority to operate in Texas

The corporation's 'legal name' as filed with the Texas Secretary of State must be provided as applicant. An 'assumed' name of a corporation is not recognized as the 'legal name' of the entity.

### **Government**

Federal, state, county, or city government (as appropriate)

The customer is either an agency of one of these levels of government or the governmental body itself. The government agency's 'legal name' must be provided as the applicant. A department name or other description of the organization is not recognized as the 'legal name'.

### **Other**

This may include a utility district, water district, tribal government, college district, council of governments, or river authority. Provide the specific type of government.

#### **e) Independent Entity**

Check No if this customer is a subsidiary, part of a larger company, or is a governmental entity. Otherwise, check Yes.

#### **f) Number of Employees**

Check one box to show the number of employees for this customer's entire company, at all locations. This is not necessarily the number of employees at the site named in the application.

**g) Customer Business Tax and Filing Numbers**

These are required for Corporations and Limited Partnerships. These are not required for Individuals, Government, and Sole Proprietors.

**State Franchise Tax ID Number**

Corporations and limited liability companies that operate in Texas are issued a franchise tax identification number. If this customer is a corporation or limited liability company, enter the Tax ID number.

**Federal Tax ID**

All businesses, except for some small sole proprietors, individuals, or general partnerships should have a federal taxpayer identification number (TIN). Enter this number here. Use no prefixes, dashes, or hyphens. Sole proprietors, individuals, or general partnerships do not need to provide a federal tax ID.

**TX SOS Charter (filing) Number**

Corporations and Limited Partnerships required to register with the Texas Secretary of State are issued a charter or filing number. You may obtain further information by calling SOS at 512-463-5555.

**DUNS Number**

Most businesses have a DUNS (Data Universal Numbering System) number issued by Dun and Bradstreet Corp. If this customer has one, enter it here.

**Section 2. APPLICATION CONTACT**

Provide the name and contact information for the person that TCEQ can contact for additional information regarding this application.

**Section 3. REGULATED ENTITY (RE) INFORMATION ON PROJECT OR SITE**

**a) Regulated Entity Number (RN)**

The RN is issued by TCEQ's Central Registry to sites where an activity is regulated by TCEQ. This is not a permit number, registration number, or license number. Search TCEQ's Central Registry to see if the site has an assigned RN at <http://www15.tceq.texas.gov/crpub/>. If this regulated entity has not been assigned an RN, leave this space blank.

If the site of your business is part of a larger business site, an RN may already be assigned for the larger site. Use the RN assigned for the larger site.

If the site is found, provide the assigned RN and provide the information for the site to be authorized through this application. The site information for this authorization may vary from the larger site information.

An example is a chemical plant where a unit is owned or operated by a separate corporation that is accessible by the same physical address of your unit or facility. Other examples include industrial parks identified by one common address but different corporations have control of defined areas within the site. In both cases, an RN would be assigned for the physical address location and the permitted sites would be identified separately under the same RN.

**b) Name of the Project or Site**

Provide the name of the site or project as known by the public in the area where the site is located. The name you provide on this application will be used in the TCEQ Central Registry as the Regulated Entity name.

**c) Description of Activity Regulated**

In your own words, briefly describe the primary business that you are doing that requires this authorization. Do not repeat the SIC Code description.

**d) County**

Provide the name of the county where the site or project is located. If the site or project is located in more than one county, provide the county names as secondary.

**e) Latitude and Longitude**

Enter the latitude and longitude of the site in degrees, minutes, and seconds or decimal form. For help obtaining the latitude and longitude, go to:

<http://www.tceq.texas.gov/gis/sqmaview.html>.

**f) Site Address/Location**

If a site has an address that includes a street number and street name, enter the complete address for the site in *Section A*. If the physical address is not recognized as a USPS delivery address, you may need to validate the address with your local police (911 service) or through an online map site used to locate a site. Please confirm this to be a complete and valid address. Do not use a rural route or post office box for a site location.

If a site does not have an address that includes a street number and street name, provide a complete written location description in *Section B*. For example: "The site is located on the north side of FM 123, 2 miles west of the intersection of FM 123 and Highway 1."

Provide the city (or nearest city) and zip code of the site location.

**Section 4. GENERAL CHARACTERISTICS**

**a) Indian Country Lands**

If your site is located on Indian Country Lands, the TCEQ does not have authority to process your application. You must obtain authorization through EPA Region 6, Dallas. Do not submit this form to TCEQ.

**b) Construction activity associated with facility associated with exploration, development, or production of oil, gas, or geothermal resources**

If your activity is associated with oil and gas exploration, development, or production, you may be under jurisdiction of the Railroad Commission of Texas (RRC) and may need to obtain authorization from EPA Region 6.

Construction activities associated with a facility related to oil, gas or geothermal resources may include the construction of a well site; treatment or storage facility; underground hydrocarbon or natural gas storage facility; reclamation plant; gas processing facility; compressor station; terminal facility where crude oil is stored prior to refining and at which refined products are stored solely for use at the facility; a

carbon dioxide geologic storage facility; and a gathering, transmission, or distribution pipeline that will transport crude oil or natural gas, including natural gas liquids, prior to refining of such oil or the use of the natural gas in any manufacturing process or as a residential or industrial fuel.

Where required by federal law, discharges of stormwater associated with construction activities under the RRC's jurisdiction must be authorized by the EPA and the RRC, as applicable. Activities under RRC jurisdiction include construction of a facility that, when completed, would be associated with the exploration, development, or production of oil or gas or geothermal resources, such as a well site; treatment or storage facility; underground hydrocarbon or natural gas storage facility; reclamation plant; gas processing facility; compressor station; terminal facility where crude oil is stored prior to refining and at which refined products are stored solely for use at the facility; a carbon dioxide geologic storage facility under the jurisdiction of the RRC; and a gathering, transmission, or distribution pipeline that will transport crude oil or natural gas, including natural gas liquids, prior to refining of such oil or the use of the natural gas in any manufacturing process or as a residential or industrial fuel. The RRC also has jurisdiction over stormwater from land disturbance associated with a site survey that is conducted prior to construction of a facility that would be regulated by the RRC. Under 33 U.S.C. §1342(l)(2) and §1362(24), EPA cannot require a permit for discharges of stormwater from field activities or operations associated with {oil and gas} exploration, production, processing, or treatment operations, or transmission facilities, including activities necessary to prepare a site for drilling and for the movement and placement of drilling equipment, whether or not such field activities or operations may be considered to be construction activities unless the discharge is contaminated by contact with any overburden, raw material, intermediate product, finished product, byproduct, or waste product located on the site of the facility. Under §3.8 of this title (relating to Water Protection), the RRC prohibits operators from causing or allowing pollution of surface or subsurface water. Operators are encouraged to implement and maintain best management practices (BMPs) to minimize discharges of pollutants, including sediment, in stormwater during construction activities to help ensure protection of surface water quality during storm events.

For more information about the jurisdictions of the RRC and the TCEQ, read the Memorandum of Understanding (MOU) between the RRC and TCEQ at 16 Texas Administrative Code, Part 1, Chapter 3, Rule 3.30, by entering the following link into an internet browser:

[http://texreg.sos.state.tx.us/public/readtac\\$ext.TacPage?sl=R&app=9&p\\_dir=&p\\_rloc=&p\\_tloc=&p\\_ploc=&pg=1&p\\_tac=&ti=16&pt=1&ch=3&rl=30](http://texreg.sos.state.tx.us/public/readtac$ext.TacPage?sl=R&app=9&p_dir=&p_rloc=&p_tloc=&p_ploc=&pg=1&p_tac=&ti=16&pt=1&ch=3&rl=30) or contact the TCEQ Stormwater Team at 512-239-4671 for additional information.

**c) Primary Standard Industrial Classification (SIC) Code**

Provide the SIC Code that best describes the construction activity being conducted at this site.

Common SIC Codes related to construction activities include:

- 1521 - Construction of Single Family Homes
- 1522 - Construction of Residential Buildings Other than Single Family Homes
- 1541 - Construction of Industrial Buildings and Warehouses



- 1542 - Construction of Non-residential Buildings, other than Industrial Buildings and Warehouses
- 1611 - Highway and Street Construction, except Highway Construction
- 1622 - Bridge, Tunnel, and Elevated Highway Construction
- 1623 - Water, Sewer, Pipeline and Communications, and Power Line Construction

For help with SIC Codes, enter the following link into your internet browser: <http://www.osha.gov/pls/imis/sicsearch.html> or you can contact the TCEQ Small Business and Local Government Assistance Section at 800-447-2827 for assistance.

**d) Secondary SIC Code**

Secondary SIC Code(s) may be provided. Leave this blank if not applicable. For help with SIC Codes, enter the following link into your internet browser: <http://www.osha.gov/pls/imis/sicsearch.html> or you can contact the TCEQ Small Business and Environmental Assistance Section at 800-447-2827 for assistance.

**e) Total Number of Acres Disturbed**

Provide the approximate number of acres that the construction site will disturb. Construction activities that disturb less than one acre, unless they are part of a larger common plan that disturbs more than one acre, do not require permit coverage. Construction activities that disturb between one and five acres, unless they are part of a common plan that disturbs more than five acres, do not require submission of an NOI. Therefore, the estimated area of land disturbed should not be less than five, unless the project is part of a larger common plan that disturbs five or more acres. Disturbed means any clearing, grading, excavating, or other similar activities.

If you have any questions about this item, please contact the stormwater technical staff by phone at 512-239-4671 or by email at [swgp@tceq.texas.gov](mailto:swgp@tceq.texas.gov).

**f) Common Plan of Development**

Construction activities that disturb less than five acres do not require submission of an NOI unless they are part of a common plan of development or for sale where the area disturbed is five or more acres. Therefore, the estimated area of land disturbed should not be less than five, unless the project is part of a larger common plan that disturbs five or more acres. Disturbed means any clearing, grading, excavating, or other similar activities.

For more information on what a common plan of development is, refer to the definition of “Common Plan of Development” in the Definitions section of the general permit or enter the following link into your internet browser:

[www.tceq.texas.gov/permitting/stormwater/common\\_plan\\_of\\_development\\_steps.html](http://www.tceq.texas.gov/permitting/stormwater/common_plan_of_development_steps.html)

For further information, go to the TCEQ stormwater construction webpage enter the following link into your internet browser: [www.tceq.texas.gov/goto/construction](http://www.tceq.texas.gov/goto/construction) and search for “Additional Guidance and Quick Links”. If you have any further questions about the Common Plan of Development you can contact the TCEQ Stormwater Team at 512-239-4671 or the TCEQ Small Business and Environmental Assistance at 800-447-2827.

**g) Estimated Start Date of the Project**

This is the date that any construction activity or construction support activity is initiated at the site. If renewing the permit provide the original start date of when construction activity for this project began.

**h) Estimated End Date of the Project**

This is the date that any construction activity or construction support activity will end and final stabilization will be achieved at the site.

**i) Will concrete truck washout be performed at the site?**

Indicate if you expect that operators of concrete trucks will washout concrete trucks at the construction site.

**j) Identify the water body(s) receiving stormwater runoff**

The stormwater may be discharged directly to a receiving stream or through a MS4 from your site. It eventually reaches a receiving water body such as a local stream or lake, possibly via a drainage ditch. You must provide the name of the water body that receives the discharge from the site (a local stream or lake).

If your site has more than one outfall you need to include the name of the first water body for each outfall, if they are different.

**k) Identify the segment number(s) of the classified water body(s)**

Identify the classified segment number(s) receiving a discharge directly or indirectly. Enter the following link into your internet browser to find the segment number of the classified water body where stormwater will flow from the site:

[www.tceq.texas.gov/waterquality/monitoring/viewer.html](http://www.tceq.texas.gov/waterquality/monitoring/viewer.html) or by contacting the TCEQ Water Quality Division at (512) 239-4671 for assistance.

You may also find the segment number in TCEQ publication GI-316 by entering the following link into your internet browser: [www.tceq.texas.gov/publications/gi/gi-316](http://www.tceq.texas.gov/publications/gi/gi-316) or by contacting the TCEQ Water Quality Division at (512) 239-4671 for assistance.

If the discharge is into an unclassified receiving water and then crosses state lines prior to entering a classified segment, select the appropriate watershed:

- 0100 (Canadian River Basin)
- 0200 (Red River Basin)
- 0300 (Sulfur River Basin)
- 0400 (Cypress Creek Basin)
- 0500 (Sabine River Basin)

Call the Water Quality Assessments section at 512-239-4671 for further assistance.

**l) Discharge into MS4 – Identify the MS4 Operator**

The discharge may initially be into a municipal separate storm sewer system (MS4). If the stormwater discharge is into an MS4, provide the name of the entity that operates the MS4 where the stormwater discharges. An MS4 operator is often a city, town, county, or utility district, but possibly can be another form of government. Please note that the Construction General Permit requires the Operator to supply the MS4 with a

copy of the NOI submitted to TCEQ. For assistance, you may call the technical staff at 512-239-4671.

**m) Discharges to the Edwards Aquifer Recharge Zone and Certification**

The general permit requires the approved Contributing Zone Plan or Water Pollution Abatement Plan to be included or referenced as a part of the Stormwater Pollution Prevention Plan.

See maps on the TCEQ website to determine if the site is located within the Recharge Zone, Contributing Zone, or Contributing Zone within the Transition Zone of the Edwards Aquifer by entering the following link into an internet browser:

[www.tceq.texas.gov/field/eapp/viewer.html](http://www.tceq.texas.gov/field/eapp/viewer.html) or by contacting the TCEQ Water Quality Division at 512-239-4671 for assistance.

If the discharge or potential discharge is within the Recharge Zone, Contributing Zone, or Contributing Zone within the Transition Zone of the Edwards Aquifer, a site-specific authorization approved by the Executive Director under the Edwards Aquifer Protection Program (30 TAC Chapter 213) is required before construction can begin.

For questions regarding the Edwards Aquifer Protection Program, contact the appropriate TCEQ Regional Office. For projects in Hays, Travis and Williamson Counties: Austin Regional Office, 12100 Park 35 Circle, Austin, TX 78753, 512-339-2929. For Projects in Bexar, Comal, Kinney, Medina and Uvalde Counties: TCEQ San Antonio Regional Office, 14250 Judson Rd., San Antonio, TX 78233-4480, 210-490-3096.

**Section 5. NOI CERTIFICATION**

**Note: Failure to indicate Yes to all of the certification items may result in denial of coverage under the general permit.**

**a) Certification of Understanding the Terms and Conditions of Construction General Permit (TXR150000)**

Provisional coverage under the Construction General Permit (TXR150000) begins 7 days after the completed paper NOI is postmarked for delivery to the TCEQ. Electronic applications submitted through ePermits have immediate provisional coverage. You must obtain a copy and read the Construction General Permit before submitting your application. You may view and print the Construction General Permit for which you are seeking coverage at the TCEQ web site by entering the following link into an internet browser: [www.tceq.texas.gov/goto/construction](http://www.tceq.texas.gov/goto/construction) or you may contact the TCEQ Stormwater processing Center at 512-239-3700 for assistance.

**b) Certification of Legal Name**

The full legal name of the applicant as authorized to do business in Texas is required. The name must be provided exactly as filed with the Texas Secretary of State (SOS), or on other legal documents forming the entity, that is filed in the county where doing business. You may contact the SOS at 512-463 5555, for more information related to filing in Texas.

**c) Understanding of Notice of Termination**

A permittee shall terminate coverage under the Construction General Permit through the submittal of a NOT when the operator of the facility changes, final stabilization has

been reached, the discharge becomes authorized under an individual permit, or the construction activity never began at this site.

**d) Certification of Stormwater Pollution Prevention Plan**

The SWP3 identifies the areas and activities that could produce contaminated runoff at your site and then tells how you will ensure that this contamination is mitigated. For example, in describing your mitigation measures, your site's plan might identify the devices that collect and filter stormwater, tell how those devices are to be maintained, and tell how frequently that maintenance is to be carried out. You must develop this plan in accordance with the TCEQ general permit requirements. This plan must be developed and implemented before you complete this NOI. The SWP3 must be available for a TCEQ investigator to review on request.

**Section 6. APPLICANT CERTIFICATION SIGNATURE**

The certification must bear an original signature of a person meeting the signatory requirements specified under 30 Texas Administrative Code (TAC) §305.44.

**If you are a corporation:**

The regulation that controls who may sign an NOI or similar form is 30 Texas Administrative Code §305.44(a)(1) (see below). According to this code provision, any corporate representative may sign an NOI or similar form so long as the authority to sign such a document has been delegated to that person in accordance with corporate procedures. By signing the NOI or similar form, you are certifying that such authority has been delegated to you. The TCEQ may request documentation evidencing such authority.

**If you are a municipality or other government entity:**

The regulation that controls who may sign an NOI or similar form is 30 Texas Administrative Code §305.44(a)(3) (see below). According to this code provision, only a ranking elected official or principal executive officer may sign an NOI or similar form. Persons such as the City Mayor or County Commissioner will be considered ranking elected officials. In order to identify the principal executive officer of your government entity, it may be beneficial to consult your city charter, county or city ordinances, or the Texas statute(s) under which your government entity was formed. An NOI or similar document that is signed by a government official who is not a ranking elected official or principal executive officer does not conform to §305.44(a)(3). The signatory requirement may not be delegated to a government representative other than those identified in the regulation. By signing the NOI or similar form, you are certifying that you are either a ranking elected official or principal executive officer as required by the administrative code. Documentation demonstrating your position as a ranking elected official or principal executive officer may be requested by the TCEQ.

If you have any questions or need additional information concerning the signatory requirements discussed above, please contact the TCEQ's Environmental Law Division at 512-239-0600.

## 30 Texas Administrative Code

### §305.44. Signatories to Applications

(a) All applications shall be signed as follows.

(1) For a corporation, the application shall be signed by a responsible corporate officer. For purposes of this paragraph, a responsible corporate officer means a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the

corporation; or the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding \$25 million (in second-quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures. Corporate procedures governing authority to sign permit or post-closure order applications may provide for assignment or delegation to applicable corporate positions rather than to specific individuals.

(2) For a partnership or sole proprietorship, the application shall be signed by a general partner or the proprietor, respectively.

(3) For a municipality, state, federal, or other public agency, the application shall be signed by either a principal executive officer or a ranking elected official. For purposes of this paragraph, a principal executive officer of a federal agency includes the chief executive officer of the agency, or a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., regional administrator of the EPA).

# Texas Commission on Environmental Quality General Permit Payment Submittal Form

**Use this form to submit your Application Fee only if you are mailing your payment.**

## Instructions:

- Complete items 1 through 5 below:
- Staple your check in the space provided at the bottom of this document.
- *Do not mail this form with your NOI form.*
- *Do not mail this form to the same address as your NOI.*

## Mail this form and your check to either of the following:

### *By Regular U.S. Mail*

Texas Commission on Environmental Quality  
Financial Administration Division  
Cashier's Office, MC-214  
P.O. Box 13088  
Austin, TX 78711-3088

### *By Overnight or Express Mail*

Texas Commission on Environmental Quality  
Financial Administration Division  
Cashier's Office, MC-214  
12100 Park 35 Circle  
Austin, TX 78753

**Fee Code: GPA General Permit: TXR150000**

1. Check or Money Order No:
2. Amount of Check/Money Order:
3. Date of Check or Money Order:
4. Name on Check or Money Order:
5. NOI Information:

If the check is for more than one NOI, list each Project or Site (RE) Name and Physical Address exactly as provided on the NOI. **Do not submit a copy of the NOI with this form, as it could cause duplicate permit application entries!**

If there is not enough space on the form to list all of the projects or sites the authorization will cover, then attach a list of the additional sites.

Project/Site (RE) Name:

Project/Site (RE) Physical Address:

**Staple the check or money order to this form in this space.**

ATTACHMENT 2



# SMALL CONSTRUCTION SITE NOTICE

FOR THE  
 Texas Commission on Environmental Quality (TCEQ)  
 Stormwater Program  
**TPDES GENERAL PERMIT TXR150000**

The following information is posted in compliance with **Part II.E.2.** of the TCEQ General Permit Number TXR150000 for discharges of stormwater runoff from small construction sites. Additional information regarding the TCEQ stormwater permit program may be found on the internet at:

[http://www.tceq.state.tx.us/nav/permits/wq\\_construction.html](http://www.tceq.state.tx.us/nav/permits/wq_construction.html)

Operator Name:	
Contact Name and Phone Number:	
Project Description: <i>Physical address or description of the site's location, estimated start date and projected end date, or date that disturbed soils will be stabilized</i>	
Location of Stormwater Pollution Prevention Plan:	

For Small Construction Activities Authorized Under Part II.E.2. (Obtaining Authorization to Discharge) the following certification must be completed:

I \_\_\_\_\_ (Typed or Printed Name Person Completing This Certification) certify under penalty of law that I have read and understand the eligibility requirements for claiming an authorization under Part II.E.2. of TPDES General Permit TXR150000 and agree to comply with the terms of this permit. A stormwater pollution prevention plan has been developed and will be implemented prior to construction, according to permit requirements. A copy of this signed notice is supplied to the operator of the MS4 if discharges enter an MS4. I am aware there are significant penalties for providing false information or for conducting unauthorized discharges, including the possibility of fine and imprisonment for knowing violations.

Signature and Title \_\_\_\_\_ Date \_\_\_\_\_

\_\_\_\_\_ Date Notice Removed

\_\_\_\_\_ MS4 operator notified per Part II.F.3.

ATTACHMENT 3

TPDES OPERATOR'S INFORMATION

Owner's Name and Address: City of Houston

Mr. \_\_\_\_\_  
(City Official)

\_\_\_\_\_  
(Department)  
1002 Washington Ave, 2<sup>nd</sup> FL  
Houston, TX 77002  
(832) 394-9108

Contractors' Names and Addresses:

General Contractor: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
Telephone: \_\_\_\_\_

Site Superintendent: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
Telephone: \_\_\_\_\_

Erosion Control and  
Maintenance Inspection: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
Telephone: \_\_\_\_\_

Subcontractors' Names and Addresses:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
Phone: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
Phone: \_\_\_\_\_

**Note: Insert name, address, and telephone number of person or firms**



**ATTACHMENT 4**

**CONTRACTOR'S / SUBCONTRACTOR'S  
CERTIFICATION FOR TPDES PERMITTING**

I certify under penalty of law that I understand the terms and conditions of TPDES General Permit No. TXR150000 and the Storm Water Pollution Prevention Plan for the construction site identified as part of this certification.

Signature:

---

Name: (printed or typed)

---

Title:

---

Company:

---

Address:

---

Date:

---

Signature:

---

Name: (printed or typed)

---

Title:

---

Company:

---

Address:

---

Date:

---

Signature:

---

Name: (printed or typed)

---

Title:

---

Company:

---

Address:

---

Date:

---

**ATTACHMENT 5**



**City of Houston**  
Storm Water Quality  
Construction Site Activities Inspection Report

TCEQ Stormwater Discharge Permit Number \_\_\_\_\_

COH Storm Water Quality Permit Number \_\_\_\_\_

COH Building Permit Login Number \_\_\_\_\_

NAME \_\_\_\_\_ DATE \_\_\_\_\_

ADDRESS \_\_\_\_\_

- No exceptions noted.  
**The following deficiencies have been noted:**
- NOI / Construction Site Notice Improperly Posted
- Stormwater Pollution Prevention Plan Incomplete or requires updating
- Copy of NOI / CSN not on site
- Storm Water Pollution Prevention Plan not on site
- Erosion and sediment controls improperly installed
- Erosion and sediment control devices improperly maintained
- Fueling/washout/chemical storage areas not properly protected
- Portocan or other sanitary facilities not properly protected or leaking
- Self-inspection and maintenance records incomplete
- Sediment from site outside area of construction
- Other (see description below)

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**The deficiencies must be corrected:**  
 immediately;  within 48 hours;  
 prior to re-inspection

Should the noted deficiencies not be corrected in the time frame indicated, further enforcement remedies will be sought.

For questions concerning the above:  
Please contact the Storm Water Quality Group at  
1002 Washington Avenue, 2nd Floor, Houston TX 77002  
832-394-9108

\_\_\_\_\_  
Inspector's Name

\_\_\_\_\_  
Operator's Signature

\_\_\_\_\_  
Inspector's Cell Phone

\_\_\_\_\_  
Operator's Name  
 not present

Distribution: white – Stormwater Quality Engineer gold – operator

**ATTACHMENT 6**

TCEQ Office Use Only  
Permit No:  
CN:  
RN:  
Region:



**Notice of Termination (NOT) for Authorizations under  
TPDES General Permit TXR150000**

**IMPORTANT INFORMATION:**

Please read and use the General Information and Instructions prior to filling out each question in the form.

Effective September 1, 2018, this paper form must be submitted to TCEQ with a completed electronic reporting waiver form (TCEQ-20754).

**ePermits: This form is available on our online permitting system.**

Sign up for online permitting at: <https://www3.tceq.texas.gov/steers/>

**What is the permit number to be terminated?**

TXR15 [redacted] TXRCW [redacted]

**Section 1. OPERATOR (Permittee)**

a) What is the Customer Number (CN) issued to this entity?

CN [redacted]

b) What is the Legal Name of the current permittee?

[redacted]

c) Provide the contact information for the Operator (Responsible Authority).

Prefix (Mr. Ms. or Miss): [redacted]

First and Last Name: [redacted] Suffix: [redacted]

Title: [redacted] Credentials: [redacted]

Phone Number: [redacted] Fax Number: [redacted]

Email: [redacted]

Mailing Address: [redacted]

City, State, and Zip Code: [redacted]

Country Mailing Information, if outside USA: [redacted]

**Section 2. APPLICATION CONTACT**

This is the person TCEQ will contact if additional information is needed regarding this application.

Is the application contact the same as the permittee identified above?

Yes, go to Section 3.

No, complete section below

Prefix (Mr. Ms. or Miss): [REDACTED]

First and Last Name: [REDACTED] Suffix: [REDACTED]

Title: [REDACTED] Credentials: [REDACTED]

Phone Number: [REDACTED] Fax Number: [REDACTED]

Email: [REDACTED]

Mailing Address: [REDACTED]

City, State, and Zip Code: [REDACTED]

Country Mailing Information, if outside USA: [REDACTED]

**Section 3. REGULATED ENTITY (RE) INFORMATION ON PROJECT OR SITE**

a) TCEQ issued RE Reference Number (RN): RN [REDACTED]

b) Name of project or site as known by the local community: [REDACTED]

c) County, or counties if more than 1: [REDACTED]

d) Latitude: [REDACTED] Longitude: [REDACTED]

e) Site Address/Location:

If the site has a physical address such as 12100 Park 35 Circle, Austin, TX 78753, complete Section 3A.

If the site does not have a physical address, provide a location description in Section 3B. Example: located on the north side of FM 123, 2 miles west of the intersection of FM 123 and Highway 1.

**Section 3A: Physical Address of Project or Site:**

Street Number and Name: [REDACTED]

City, State, and Zip Code: [REDACTED]

**Section 3B: Site Location Description:**

**Location description:** [REDACTED]  
[REDACTED]

City where the site is located or, if not in a city, what is the nearest city: [REDACTED]

Zip Code where the site is located: [REDACTED]

**Section 4. REASON FOR TERMINATION**

Check the reason for termination:

Final stabilization has been achieved on all portions of the site that are the responsibility of the Operator and all silt fences and other temporary erosion controls have been removed, or scheduled for removal as defined in the SWP3.

- Another permitted Operator has assumed control over all areas of the site that have not been finally stabilized, and temporary erosion controls that have been identified in the SWP3 have been transferred to the new Operator.
- The discharge is now authorized under an alternate TPDES permit.
- The activity never began at this site that is regulated under the general permit.

**Section 5. CERTIFICATION**

Signatory Name: [REDACTED]

Signatory Title: [REDACTED]

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

I further certify that I am authorized under 30 Texas Administrative Code §305.44 to sign and submit this document, and can provide documentation in proof of such authorization upon request.

Signature (use blue ink): \_\_\_\_\_ Date: \_\_\_\_\_

# Instructions for Notice of Termination (NOT) for Authorizations under TPDES General Permit TXR150000

## GENERAL INFORMATION

### Where to Send the Notice of Termination (NOT):

#### BY REGULAR U.S. MAIL:

Texas Commission on Environmental Quality  
Stormwater Processing Center (MC-228)  
P.O. Box 13087  
Austin, Texas 78711-3087

#### BY OVERNIGHT/EXPRESS MAIL:

Texas Commission on Environmental Quality  
Stormwater Processing Center (MC-228)  
12100 Park 35 Circle  
Austin, TX 78753

### TCEQ Contact List:

Application status and form questions:	512-239-3700, <a href="mailto:swpermit@tceq.texas.gov">swpermit@tceq.texas.gov</a>
Technical questions:	512-239-4671, <a href="mailto:swgp@tceq.texas.gov">swgp@tceq.texas.gov</a>
Environmental Law Division:	512-239-0600
Records Management - obtain copies of forms:	512-239-0900
Reports from databases (as available):	512-239-DATA (3282)
Cashier's office:	512-239-0357 or 512-239-0187

### Notice of Termination Process:

A Notice of Termination is **effective on the date postmarked for delivery to TCEQ.**

When your NOT is received by the program, the form will be processed as follows:

- 1) Administrative Review: The form will be reviewed to confirm the following:
  - the permit number is provided;
  - the permit is active and has been approved;
  - the entity terminating the permit is the current permittee;
  - the site information matches the original permit record; and
  - the form has the required original signature with title and date.
- 2) Notice of Deficiency: If an item is incomplete or not verifiable as indicated above, a phone call will be made to the applicant to clear the deficiency. A letter will not be sent to the permittee if unable to process the form.
- 3) Confirmation of Termination: A Notice of Termination Confirmation letter will be mailed to the operator.

### Change in Operator:

An authorization under the general permit is not transferable. If the operator of the regulated entity changes, the present permittee must submit a Notice of Termination and the new operator must submit a Notice of Intent. The NOT and NOI must be submitted not later than 10 days prior to the change in Operator status.

## INSTRUCTIONS FOR FILLING OUT THE FORM

The majority of permit information related to the current operator and regulated entity are available at the following website: [http://www2.tceq.texas.gov/wq\\_dpa/index.cfm](http://www2.tceq.texas.gov/wq_dpa/index.cfm).

## **Section 1. Operator (Current Permittee):**

- a) Customer Number (CN)  
TCEQ's Central Registry assigns each customer a number that begins with CN, followed by nine digits. This is not a permit number, registration number, or license number. The Customer Number, for the current permittee, is available at the following website:  
[http://www2.tceq.texas.gov/wq\\_dpa/index.cfm](http://www2.tceq.texas.gov/wq_dpa/index.cfm).

- b) Legal Name of Operator  
The operator must be the same entity as previously submitted on the original Notice of Intent for the permit number provided. The current operator name, as provided on the current authorization, is available at the following website:  
[http://www2.tceq.texas.gov/wq\\_dpa/index.cfm](http://www2.tceq.texas.gov/wq_dpa/index.cfm).

- c) Contact Information for the Operator (Responsible Authority)  
Provide information for person signing the NOT application in the Certification section. This person is also referred to as the Responsible Authority.

Provide a complete mailing address for receiving mail from the TCEQ. Update the address if different than previously submitted for the Notice of Intent or Notice of Change. The mailing address must be recognized by the US Postal Service. You may verify the address on the following website: <https://tools.usps.com/go/ZipLookupAction!input.action>.

The phone number should provide contact to the operator.

The fax number and e-mail address are optional and should correspond to the operator.

## **Section 2. Application Contact:**

Provide the name, title and contact information of the person that TCEQ can contact for additional information regarding this application.

## **Section 3. Regulated Entity (RE) Information on Project or Site:**

- a) Regulated Entity Reference Number (RN)  
A number issued by TCEQ's Central Registry to sites where an activity regulated by TCEQ. This is not a permit number, registration number, or license number. The Regulated Entity Reference Number is available at the following website:  
[http://www2.tceq.texas.gov/wq\\_dpa/index.cfm](http://www2.tceq.texas.gov/wq_dpa/index.cfm).
- b) Name of the Project or Site  
Provide the name of the site as known by the public in the area where the site is located.
- c) County  
Identify the county or counties in which the regulated entity is located.
- d) Latitude and Longitude  
Enter the latitude and longitude of the site in degrees, minutes, and seconds or decimal form. The latitude and longitude as provided on the current authorization is available at the following website: [http://www2.tceq.texas.gov/wq\\_dpa/index.cfm](http://www2.tceq.texas.gov/wq_dpa/index.cfm).
- e) Site/Project (RE) Physical Address/Location Information  
The physical address/location information, as provided on the current authorization, is available at the following website: [http://www2.tceq.texas.gov/wq\\_dpa/index.cfm](http://www2.tceq.texas.gov/wq_dpa/index.cfm).

Section 3A. If a site has an address that includes a street number and street name, enter the complete address for the site. If the physical address is not recognized as a USPS delivery address, you may need to validate the address with your local police (911 service) or through an online map site used to locate the site. Please confirm this to be a complete and valid address. Do not use a rural route or post office box for a site location.

Section 3B. If a site does not have an address that includes a street number and street name, provide a complete written location description. For example: "The site is located on the north side of FM 123, 2 miles west of the intersection of FM 123 and Highway 1."

Provide the city (or nearest city) and Zip Code of the facility location.

#### **Section 4. Reason for Termination:**

The Notice of Termination form is only for use to terminate the authorization (permit). The Permittee must indicate the specific reason for terminating by checking one of the options. If the reason is not listed then provide an attachment that explains the reason for termination.

Please read your general permit carefully to determine when to terminate your permit. Permits will not be reactivated after submitting a termination form. The termination is effective on the date postmarked for delivery to TCEQ.

#### **Section 5. Certification:**

The certification must bear an original signature of a person meeting the signatory requirements specified under 30 Texas Administrative Code §305.44.

##### *IF YOU ARE A CORPORATION:*

The regulation that controls who may sign an application form is 30 Texas Administrative Code §305.44(a), which is provided below. According to this code provision, any corporate representative may sign an NOI or similar form so long as the authority to sign such a document has been delegated to that person in accordance with corporate procedures. By signing the NOI or similar form, you are certifying that such authority has been delegated to you. The TCEQ may request documentation evidencing such authority.

##### *IF YOU ARE A MUNICIPALITY OR OTHER GOVERNMENT ENTITY:*

The regulation that controls who may sign an NOI or similar form is 30 Texas Administrative Code §305.44(a), which is provided below. According to this code provision, only a ranking elected official or principal executive officer may sign an NOI or similar form. Persons such as the City Mayor or County Commissioner will be considered ranking elected officials. In order to identify the principal executive officer of your government entity, it may be beneficial to consult your city charter, county or city ordinances, or the Texas statutes under which your government entity was formed. An NOI or similar document that is signed by a government official who is not a ranking elected official or principal executive officer does not conform to §305.44(a) (3). The signatory requirement may not be delegated to a government representative other than those identified in the regulation. By signing the NOI or similar form, you are certifying that you are either a ranking elected official or principal executive officer as required by the administrative code. Documentation demonstrating your position as a ranking elected official or principal executive officer may be requested by the TCEQ.

If you have any questions or need additional information concerning the signatory requirements discussed above, please contact the Texas Commission on Environmental Quality's Environmental Law Division at 512-239-0600.



*30 Texas Administrative Code §305.44. Signatories to Applications*

(a) All applications shall be signed as follows.

(1) For a corporation, the application shall be signed by a responsible corporate officer. For purposes of this paragraph, a responsible corporate officer means a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation; or the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding \$25 million (in second-quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures. Corporate procedures governing authority to sign permit or post-closure order applications may provide for assignment or delegation to applicable corporate positions rather than to specific individuals.

(2) For a partnership or sole proprietorship, the application shall be signed by a general partner or the proprietor, respectively.

(3) For a municipality, state, federal, or other public agency, the application shall be signed by either a principal executive officer or a ranking elected official. For purposes of this paragraph, a principal executive officer of a federal agency includes the chief executive officer of the agency, or a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., regional administrator of the EPA).

**SECTION 01507**  
**TEMPORARY SIGNS**

PART 1- GENERAL

1.01 SECTION INCLUDES

- A. Temporary signs at construction access points.
- B. Maintenance.
- C. Removal.
- D. Project and Contractor identity signs are not permitted.

1.02 QUALITY ASSURANCE

- A. Design signs and supporting sign structure to remain in place and withstand 50 miles-per-hour wind velocity.
- B. Sign Manufacturer/Maker/Painter: Experienced professional sign company.
- C. Finishes, Painting: Withstand weathering, fading, and chipping for duration of construction.
- D. Appearance: Fresh, new-looking, legible and neat look during the entire period during which required.

1.03 SUBMITTALS

- A. Follow Section 01340 - Shop Drawings, Product Data and Samples.
- B. Submit shop drawings including:
  - 1. Signboards and Copy: Show to-scale size, dimensions, content, layout, font style and size, and colors.
  - 2. Location of each sign.

PART 2 PRODUCTS

2.01 TEMPORARY SIGNS FOR ACCESS POINTS

- A. Posts for Exterior Signs: New 4x4 inch moisture-resistant-treated wood or 2-1/2-inch diameter by 12-foot long galvanized steel.
  - 1. Unpainted.

2. Fabricate to length required for 3-foot direct-bury plus aboveground length required for proper height of signboard mounting.
3. Furnish number of posts as required for proper support of signboard

B. Signboards:

1. For Exterior Signs: 3/4-inch-thick exterior grade medium density overlay (MDO) plywood, or 3/16-inch sheet aluminum. Paint background [black] [white] [ ] [as shown on Drawings].

a. Contractor's Option: Use colored vinyl film in lieu of paint for aluminum.

2. For Interior Signs: 3/4-inch-thick fire-retardant treated medium density overlay plywood, or colored plastic laminate cladding both faces and with painted edges, or 1/8-inch sheet aluminum. Paint background black.

a. Contractor's Option: Use colored vinyl film in lieu of paint for aluminum.

- C. Color Coating for Signboards and Hashmarks: Flat ultraviolet inhibited acrylic polyurethane or matte vinyl, all visible surfaces.

- D. Copy and Borders: Flat color (color as scheduled) vinyl die-cut, Helvetica Medium typeface, size as shown or scheduled.

- E. Rough Hardware: [For wood, galvanized steel or brass for fasteners and other hardware] [For aluminum, cadmium-plated steel or stainless steel].

- F. Skid-mounted Signs: Allowed only when approved by the City Engineer. Approval does not release Contractor from responsibility of maintaining temporary signs on site and does not make City responsible for security of temporary signs.

## 2.03 SIGN FABRICATION

- A. Fabricate signboards and install copy in the shop.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install temporary signs at construction area access points, including within security areas and AOA, at following location:

1. As scheduled below.
2. Where shown on Drawings.
3. Where required by City Engineer.

**TEMPORARY SIGNS**

- 
- B. Install signs fully visible, legible, level and plumb.

3.02 MAINTENANCE

- A. Maintain signs and supports and markings clean. Repair deterioration and damage.
- B. Relocate signs as work progresses [at each site] [at each stage] [at both] at no additional cost to the City.

3.03 REMOVAL

- A. Remove temporary sign work when control is no longer needed or as directed by City Engineer.

3.04 MESSAGE SCHEDULE

- A. Construction Entrance Warning Sign: 3 by 2-foot signboard, white copy and border on black background. Surface-mount on access gates through fences and on doors through barricades or enclosures; at 50 feet on center unless otherwise required by governing agencies:

NO ENTRANCE (4 inch)

CONSTRUCTION AREA (4 inch)

(45-degree hash marks, full width) (2 inch)

Hard Hat Required (2 inch)

Security Badge Required (2 inch)

- B. Emergency Egress Sign: One-foot square signboard, white copy and border, with directional arrow, on black background. Surface-mount on fences, barricades or enclosures, or freestanding, spaced 50 feet on center along path of egress, unless otherwise required by governing agencies.

EXIT (4 inch)

(Arrow direction as appropriate to egress path) (6 inch)

- C. No Entrance to Closed Parking Area: 8 by 4-foot signboard, white copy and border on black background, free-standing; at each ramp access to floor on which work occurs:

NO ENTRANCE (6 inch)

CONSTRUCTION AREA (6 inch)

(45-degree hash marks, full width (4 inch)

This Parking Area Closed (4 inch)

Until (Insert Date) (4 inch)

- D. Notice of Intent to Close Parking Area: 8 by 4-foot signboard, white copy and border on black background, free-standing; at each ramp access to floor on which work occurs:

WARNING (6 inch)

THIS PARKING LEVEL (6 inch)

WILL BE CLOSED (6 inch)

(45-degree hash marks, full width) (4 inch)

Do Not Park on This Level (4 inch)

From (Insert Date) (4 inch)

Until (Insert Date) (4 inch)

END OF SECTION

**SECTION 01550**

**PUBLIC SAFETY & CONTRACTOR'S SAFETY STAFFING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Public Safety and Convenience
- B. General Requirements
- C. Street Markers and Traffic Control Signs
- D. Contractor's Safety Staffing Requirements

**1.02 RELATED SECTIONS**

- A. Section 00700 - General Conditions
- B. Section 01555 – Traffic Control & Regulations
- C. Section 01561 – Trench Safety System

**1.03 PUBLIC SAFETY AND CONVENIENCE**

- A. The Work in this Project is to be performed [edit wording for scope of work and coord. w/other const. Projects going on in the immediate area]. The Contractor shall furnish and maintain appropriate barricades and signage required to maintain a safe work environment for the HAS employees, the public and construction staff working at the project site.
- B. Contractor shall plan and execute his operations in a manner that will cause a minimum interference with other construction projects.
- C. Signs, barricades and warning devices informing public of construction features will be placed and maintained by Contractor, who shall be solely responsible for their maintenance.
- D. Contractor shall perform the necessary cleanup and finishing immediately after all or a portion of the Work is completed.
- E. All fire hydrants and water control valves shall be kept free from obstruction and available for use at all times.

**1.04 GENERAL REQUIREMENTS**

**PUBLIC SAFETY & CONTRACTOR'S  
SAFETY STAFFING**

- A. The Contractor shall observe the rules and regulations of the State of Texas and agencies of the U.S. Government which prohibit the pollution of any lake, stream, river, or wetland by dumping of any refuse, rubbish, dredge material, or debris therein.
- B. The Contractor is specifically cautioned that disposal of materials into any water of the State must conform to the requirements of the Texas Natural Resource Conservation Commission (TNRCC), and any applicable permit from the US Army Corps of Engineers.
- C. Waste material must be disposed of at sites approved by the Owner's Representative and permitted by the City.

1.05 CONTRACTOR'S SAFETY STAFFING REQUIREMENTS

- A. Refer to Section 00700 – General Conditions, Article 10 – Safety Precautions

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF DOCUMENT

**SECTION 01555**

**TRAFFIC CONTROL AND REGULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Signs, signals, lights and control devices.
- B. Flagmen.
- C. Construction parking control.
- D. Designated haul routes.
- E. Construction Traffic Control Plan.
- F. See also Section 01145 - Use of Premises.

1.02 DEFINITIONS

- A. See Section 01312 - Coordination and Meetings for definition of terms related to Aircraft Operations Area (AOA).
- B. Flagman: A person who has successfully fulfilled the “Certified Flagman” requirements set forth by the Texas Department of Transportation. Flagman certification may be achieved either through the Texas Department of Transportation, Texas Engineering Extension Services (TEEX), the City of Houston’s E.B Cape Training Center, or by a trained and certified flagman instructor, employed by the Contractor. The certified flagman must carry proof of certification while performing flagman duties. The certified flagman will be required to wear a distinctive, bright colored vest and be equipped with appropriate flagging and communication devices. He/she must be fluent in English (speaking, reading, writing), with Spanish an advantageous, but not required, primary or secondary language.
- C. Peace Officer: A licensed police officer actively employed in a full-time capacity as a peace officer, working on average, minimum 32 paid hours per week, at a rate not less than the prevailing minimum rate following the Federal Wage and Hour Act, and entitled to full benefits as a peace officer, and who receives compensation for private employment as an individual employee or independent contractor. Private employment may be either in employee-employer relationship or on an individual contractual basis. He/she must be fluent in English (speaking, reading, writing) with Spanish an advantageous, but not required, primary or secondary language.



**TRAFFIC CONTROL AND REGULATION**

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- D. Uniformed Flagman: A peace officer trained in traffic control and familiar with George Bush Intercontinental Airport roadway traffic patterns and airport operation procedures. A uniformed flagman may not be a reserve peace officer.

1.03 SUBMITTALS

- A. For Contractor-proposed changes to Traffic Control and Regulation shown on Drawings, permitted only in order to reduce construction time and cost through re-sequencing the Work, prepare plan drawings and supplement with product literature, narrative description, and construction schedule.

1.04 MEASUREMENT AND PAYMENT

- A. Traffic Control and Regulation, excluding Flagmen: Measurement is on a lump sum basis, including submittal of Contractor-proposed changes. Payment will be made based on schedule of values and percent of work complete.
- B. Flagmen: Measurement is on a lump sum basis as required for the Work. Payment will be made based on schedule of values and percent of work complete.
- C. Follow Section 01290 - Payment Procedures.

1.05 CONSTRUCTION TRAFFIC CONTROL PLAN AND PROCEDURES

- A. Develop a written and graphic detailed Construction Traffic Control plan describing:
  1. Rerouting of public roadway and AOA roadway traffic (outside safety areas) showing route, duration, and methods for change over from one route to the other and return to normal.
  2. Product Deliveries: Location, space required and duration for temporary off-loading along public roadways or curbsides and along AOA roadways and around buildings adjacent to aprons, and route through occupied building interiors.
  3. Barricade locations and duration of installation. Submit barricade construction details following Section 01505 - Temporary Facilities.
  4. Maintain, update and obtain approval for changes.

PART 2 PRODUCTS

2.01 SIGNS, SIGNALS, AND DEVICES

- A. Furnish traffic cones, drums, barricades and traffic intersection lights, including control devices in AOA, following TMUTCD.

2.02 FLAGMEN AND OTHER PERSONNEL

**TRAFFIC CONTROL AND REGULATION**

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- A. Provide certified flagmen in number, at assigned, locations, and for durations as required to regulate even flow of vehicular and pedestrian traffic affected by construction activities.
- B. Employ other personnel, i.e. uniformed peace officers, to take the additional steps required to protect the Work and public, or when specifically requested by Airport Operations personnel through the City Engineer to assist flagmen in the regulating of airport roadway traffic. The uniformed peace officer will coordinate with City Engineer, contractor, and/or Airport Operations personnel, as appropriate, prior to beginning shift.
- C. Use of flagmen or peace officers does not reduce responsibility for damage for which the contractor would otherwise be liable.

**PART 3 EXECUTION**

**3.01 GENERAL**

- A. Install traffic control devices, including flagmen, at approaches to site and on site, at crossroads, detours, parking areas, at AOA, at construction entrances, and elsewhere as required to direct construction and affected public traffic, aircraft and GSE, or where directed by City Engineer and/or Airport operations personnel.
- B. As directed by appropriate authority, e.g., City Engineer, employ additional uniformed peace officers to supplement the flagmen when performing a total terminal area road closure, detour, or overnight activity that affects existing traffic patterns. The uniformed peace officer will coordinate with City Engineer, contractor, and/or Airport Operations personnel, as appropriate, prior to beginning shift.
- C. Install and operate traffic control signals to direct and maintain orderly flow of traffic in areas under Contractor's control, and areas affected by Contractor's operations.
- D. Install warning lights on traffic control devices for use during hours of low visibility to delineate traffic lanes and to guide traffic. Do not use flares or flame pots.
- E. Relocate traffic controls as Work progresses, to maintain effective traffic control.

**3.02 HAUL ROUTES**

- A. Confine construction traffic to designated haul routes.
- B. Regulate construction traffic along haul routes. Minimize interference with public traffic.
- C. Follow Texas State Highway and Public Transportation load limits of roadways.

**3.03 PUBLIC ROADS AND TERMINAL AREA OADS**

**TRAFFIC CONTROL AND REGULATION**

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- A. Abide by laws and regulations of governing authorities when using roads.
- B. Maintain road lane use as follows, unless otherwise permitted by Airport Manager or Airport Operations personnel, as coordinated through City Engineer.
  - 1. All Terminal area road lanes available from 0500 to 2200 hours; minimum two lanes in each direction at all times.
  - 2. All on-airport road lanes (outside Terminal area) available from 0500 to 0900 hours, and from 0600 to 1900 hours; minimum two lanes in each direction at all times.
- C. Maintain access at driveways. Do not block any vehicle or pedestrian traffic area without obtaining prior approval from the Houston Airport. Any unusual or otherwise unforeseen activity will require forty-eight (48) hours of notification to the City Engineer as well as Airport Operations personnel. Traffic control meetings are held weekly, on Thursdays, at 2:00 pm at a location to be identified during the pre-construction conference. Contractor shall attend these meetings to coordinate all roadway traffic impacts. Contractor must present detailed traffic control/coordination plan, including drawings, written narrative, etc., with dates, times, and durations of proposed activities. This plan must be presented a minimum of three weeks prior to intended activity.
- D. Maintain roads on airport property clean at all times. Broom or wash as required. At Terminal area roads, follow behind haul vehicles and immediately clean up roads and debris and foreign material resulting from construction operations is deposited.
- E. Follow City of Houston Ordinance 5705, Construction or Demolishing Privileges

3.04 CONSTRUCTION PARKING CONTROL

- A. Control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, and airport operations.
- B. Prevent construction personnel's vehicles in revenue-producing facilities. Maintain vehicular access to and through construction parking areas.
- C. Do not park on or adjacent to roadways or curbsides.
- D. Comply with all security directives with regard to parking in the Terminal area

3.05 REMAINING EXISTING CONTROL AND REGULATION DEVICES

- A. Leave existing control and regulation devices in place and properly operating and visible during construction, unless indicated for removal or otherwise permitted.
- B. Repair damage resulting from construction operations.

3.06 REMOVAL OF EXISTING CONTROL AND REGULATION DEVICES

**TRAFFIC CONTROL AND REGULATION**

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- A. Contact City of Houston Signal Shop Dispatcher at (713) 803-3004 before removing or deactivating existing control and regulation devices.
- B. Remove designated or permitted existing control and regulation devices following Section 01731.
- C. Unless otherwise indicated or directed, remove existing lane striping and reflective buttons in conflict with temporary control and regulation devices. Install matching temporary lane striping and reflective buttons, maintain during construction, remove after construction is complete, and install permanent matching lane striping and reflective buttons.

3.07 BRIDGING TRENCHES AND EXCAVATIONS IN ROADS

- A. Follow Section 01505 - Temporary Facilities.

3.08 REMOVAL OF TEMPORARY CONTROL AND REGULATION

- A. Remove controls and regulation when no longer required. Repair damage caused by installation.
- B. Remove post settings to a depth of 2-feet.

END OF SECTION

**SECTION 01576**  
**WASTE MATERIAL DISPOSAL**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Disposal of waste material and salvageable material.

1.02 SUBMITTALS

- A. Conform to requirements of Section 01330 - Submittal Procedures.
- B. Submit copy of approved "Development Permit", as defined in Chapter 19 of Floodplain Ordinance (City Ordinance Number 81-914 and Number 85- 1705), prior to disposal of excess material in areas designated as being in "100-year Standard Flood Hazard Area" within the City and areas designated as being in "500-year Standard Flood Hazard Area". Contact the City of Houston Floodplain Management Office at the Houston Permitting Center (1002 Washington Avenue, 3rd Floor), at (832) 394-8854 for floodplain information.
- C. Obtain and submit disposal permits for proposed disposal sites, if required by local ordinances.
- D. Submit copy of written permission from property owner, with description of property, prior to disposal of excess material adjacent to Project. Submit written and signed release from property owner upon completion of disposal work.
- E. Describe waste materials expected to be stored on-site and a description of controls to reduce Pollutants from these materials, including storage practices to minimize exposure of materials to storm water; and spill prevention and response measures in the Project's Storm Water Pollution Prevention Plan (SWPPP). Refer to Section 01410 - TPDES Requirements.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SALVAGEABLE MATERIAL

- A. Excavated Material: When indicated on Drawings, load, haul, and deposit excavated material at location or locations shown on Drawings outside limits of Project.

**WASTE MATERIAL DISPOSAL**

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- B. Base, Surface, and Bedding Material: Load shell, gravel, bituminous, or other base and surfacing material designated for salvage into City trucks.
- C. Pipe Culvert: Load culverts designated for salvage into City trucks.
- D. Other Salvageable Materials: Conform to requirements of individual Specification Sections.
- E. Coordinate loading of salvageable material on City trucks with Project Manager.

3.02 EXCESS MATERIAL

- A. Remove and legally dispose of vegetation, rubble, broken concrete, debris, asphaltic concrete pavement, excess soil, and other materials not designated for salvage from job site.
- B. Excess soil may be deposited on private property adjacent to Project when written permission is obtained from property owner. See Paragraph 1.02 D above.
- C. Verify floodplain status of any proposed disposal site. Do not dispose of excavated materials in area designated as within 100-year and 500-year Standard Flood Hazard Areas unless "Development Permit" has been obtained. Remove excess material placed in "100-year and 500-year Standard Flood Hazard Areas" within the City without "Development Permit", at no additional cost to the City.
- D. Remove waste materials from site daily, in order to maintain site in neat and orderly condition.

END OF SECTION

**BASIC PRODUCT REQUIREMENTS**

**SECTION 01610**

**BASIC PRODUCT REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements for transportation, delivery, handling, and storage of Products.

1.02 PRODUCTS

- A. Products: Defined in Document 00700 – General Conditions. Does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components designated for reuse.
- B. For material and equipment specifically indicated or specified to be reused in the work:
  - 1. Use special care in removal, handling, storage and reinstallation, to assure proper function in completed work.
  - 2. Arrange for transportation, storage and handling of products which require off-site storage, restoration or renovation. Include cost in unit price for related items.
- C. When contract documents require that installation of work comply with manufacturer's printed Instructions, obtain and distribute copies of such instructions to parties involved in installation, including two copies to Project Manager. Maintain one set of complete instructions at job site during installation until completion.
- D. Provide Products from the fewest number of manufacturers as practical, in order to simplify spare parts inventory and to allow for maximum interchangeability of components. For multiple components of the same size, type or application, use the same make and model of component throughout the Work.

1.03 TRANSPORTATION

- A. Make arrangements for transportation, delivery, and handling of Products required for timely completion of the Work.
- B. Transport and handle Products in accordance with manufacturer's instructions.
- C. Consign and address shipping documents to proper party giving name of the Project and its complete street address. Shipments shall be delivered to Contractor.

1.04 DELIVERY

**BASIC PRODUCT REQUIREMENTS**

- A. Arrange deliveries of Products to accommodate short-term site completion schedules and in ample time to facilitate inspection prior to Installation. Avoid deliveries that cause lengthy storage or overburden of limit storage space.
- B. Coordinate deliveries to avoid conflict with the Work and conditions at the site and to accommodate the following:
  - 1. Work of other contractors or the City.
  - 2. Limitations of storage space.
  - 3. Availability of equipment and personnel for handling Products.
  - 4. The City's use of premises.
- C. Have Products delivered to the site in manufacturer's original, unopened, labeled containers.
- D. Immediately upon delivery, inspect shipment to assure:
  - 1. Product complies with requirements of the Contract.
  - 2. Quantities are correct.
  - 3. Containers and packages are intact; labels are legible.
  - 4. Products are properly protected and undamaged.

1.05 PRODUCT HANDLING

- A. Coordinate off-loading of Products delivered to the site. If necessary, during construction, move and relocate stored Products at no additional cost to the City.
- B. Provide equipment and personnel necessary to handle Products, including those provided by the City, by methods to prevent damage to Products or packaging.
- C. Provide additional protection during handling as necessary to prevent breaking, scraping, marring, or otherwise damaging Products or surrounding areas.
- D. Handle Products by methods to prevent over-bending or overstressing.
- E. Lift heavy components only at designated lifting points.
- F. Handle Products by methods to prevent over-bending or overstressing.



**BASIC PRODUCT REQUIREMENTS**

- G. Do not drop, roll, or skid Products off delivery vehicles. Hand-carry or use Suitable materials handling equipment.

1.06 STORAGE OF PRODUCTS

- A. Store and protect Products in accordance with manufacturer's recommendations and requirements of these Specifications.
- B. Make necessary provisions for safe storage of Products. Place Products so as to prevent damage to any part of the Work or existing facilities and to maintain free access at all times to all parts of the Work and to utility service company installations in the vicinity of the Work. Keep Products neatly and compactly stored in locations that will cause minimum inconvenience to other contractors, public travel, adjoining owners, tenants, and occupants. Arrange storage in a manner so as to provide easy access for inspection.
- C. Restrict storage to areas available on the site for storage of Products as shown on Drawings or approved by Project Manager.
- D. Provide off-site storage and protection when on-site storage is not adequate. Provide addresses of, and access to, off-site storage locations for inspection by Project Manager.
- E. Do not use lawns, grass plots, or other private property for storage purposes without written permission of owner or other person in possession or control of premises.
- F. Protect stored Products against loss or damage.
- G. Store in manufacturers' unopened containers.
- H. Neatly, safely, and compactly stack Products delivered and stored along the line of the Work to avoid inconvenience and damage to property owners and general public and maintain at least 3 feet clearance around fire hydrants. Keep public, private driveways and street crossings open.
- I. Repair or replace damaged lawns, sidewalks, streets or other improvements to satisfaction of Project Manager. Total length that Products may be distributed along route of construction at one time is 1000 linear feet, unless otherwise approved in writing by Project Manager.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**PRODUCT OPTIONS AND SUBSTITUTIONS**

**SECTION 01630**

**PRODUCT OPTIONS AND SUBSTITUTIONS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Procedure for requesting substitution of products in lieu of those specified. These requirements supplement Paragraph 3.10 of Documents 00700 - General Conditions and 00800- Supplementary Conditions.
- B. After submittal period expires, requests for substitutions will be considered only when a specified product becomes unavailable because of conditions beyond Contractor's control.

1.02 DEFINITIONS

- A. Process: Any proprietary method for installing products that results in an integral, functioning part of the Work. For this Section, the word "product" includes "process."

1.03 SUBMITTALS

- A. Submit 5 copies of each separate product substitution request, within time period stated in Document 00700 - General Conditions, including:
  - 1. Full submittal data for specified products, following Section 01340- Shop Drawings, Product Data and Samples.
  - 2. Full data substantiating compliance of proposed substitutions with Contract Documents and substantiating equivalency with specified products:
    - a. Product identification, including manufacturer's name and address.
    - b. Manufacturer's literature with precise product description, and directly applicable performance and test data and reference standards.
    - c. Samples, as applicable.
    - d. Name and address of projects on which proposed product was used in similar or equivalent conditions within the last 3 years, and date of installation.
    - e. Name, address and telephone number of owners, designer, and installing contractor.
    - f. For process substitutions, detailed description of proposed method and drawings illustrating methods.

## PRODUCT OPTIONS AND SUBSTITUTIONS

- B. Detailed reason(s) for substitution, and tangible benefits accruing to City.
- C. Itemized comparison of proposed substitutions with specified products and full description of deviations.
- D. Fully describe all effects of substitutions on the Work and on separate contracts and work by City. Include full cost data comparing proposed substitution with specified products and amount of change in Contract Sum. Indicate changes in construction schedule (Section 01325 - Construction Schedules).
- E. Substitutions are not permitted when:
  - 1. They are not processed following Document 00700 - General Conditions and this Section.
  - 2. Acceptance will require revision of Contract Documents or will change the design concept.
  - 3. Delay in construction will occur.
  - 4. No provisions for substitutions are stated in the Contract Documents.
- F. Burden of proof of merit of proposed substitution remains solely with Contractor.

### 1.02 CONTRACTOR'S OPTIONS

- A. Options, stated as "Contractor's option(s)" in Contract Documents, are intended to benefit the Work through reduced cost, decreased construction time, or better performance within designated range of criteria.
- B. Volunteer options are not permitted.
- C. Notify in writing City Engineer of options chosen.

### 1.03 QUALITY ASSURANCE

- A. To the maximum extent possible, provide products of the same type or function from a single manufacturer, make, or source. Where more than one choice is available, select the product which is compatible with other products already selected, specified, or which is in use by City.

### 1.04 DESIGNER'S ACTIONS

**PRODUCT OPTIONS AND SUBSTITUTIONS**

- A. Decision to accept or deny proposed substitute products, or selection of one product instead of another, is solely the responsibility of Designer; such decisions and selections are final.

1.05 COSTS FOR REVIEW OF SUBSTITUTIONS

- A. Pay costs related to Designer's review and examination of proposed substitutions. Assume liability for obtaining acceptance of substitutions.
- B. Reimburse City for actual evaluation costs of Designer's(s') if proposed substitute does not meet requirements of Contract Documents, or acceptance of proposed substitute requires changes to the Work.
- C. Reimburse City for associated design costs, including redesign, additional submittal reviews, investigations, Designer's fees and revision of Contract Documents required because of the requested substitution. Design costs are the full price for additional work performed, paid at the rates established by Designer's contract with City for Design and Contract Documents phase of the Project.
- D. Pay for laboratory testing required to obtain information upon which equivalency can be determined.
- E. If Designer determines that proposed substitutions are not equivalent to specified products, furnish one of the specified products without delay in time or additional cost to City.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01640**  
**CITY-FURNISHED PRODUCTS (CFP)**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. City-furnished products (CFP), and location(s) of same, for installation by Contractor are scheduled in Part 2.
- B. Items and quantities listed are intended to establish the basis of the contract. Contractor is entitled to rely on the accuracy of the CFP list.
- C. Provide new matching products, without change in Contract Sum or Time, when quantity of properly functioning CFP is insufficient for work.

PART 2 PRODUCTS

2.01 SCHEDULE OF CFP

- A. [City will furnish [\_\_\_ quantity] ATCT radio[s] and charging unit[s], handheld, and vehicle mounted, for dedicated ATCT communications. Radio[s] will be transferred to Contractor at Preconstruction Conference (01312 - Coordination and Meetings).]
- B. [\_\_\_\_\_ located at \_\_\_\_\_.]

PART 3 EXECUTION

3.01 GENERAL

- A. Inspect CFP to verify quantity of CFP and total quantity of work using CFP.
- B. Obtain manufacturers' data, if not provided by City, and other information necessary to properly complete work.
- C. Load and transport to site, store, handle, deliver, and protect CFP following Section 01610 - Basic Product Requirements. Insure CFP while in Contractor's possession.
- D. Inspect CFP to discover defects or deficiencies and make written notice of same to City Engineer prior to taking possession. Defects and deficiencies include incorrect quantity; existing damage; incorrect labeling of contents of containers.
- E. Repair or replace defective or deficient CFP items under Allowance Item 1 following Section 01210 - Cash Allowances.

**CITY FURNISHED PRODUCTS**

- F. Schedule inspection and receipt of CFP products to prevent delay. Notify City Engineer in writing, at least 7 days before products are scheduled for Contractor's inspection or receipt.
- G. Prepare Document 00685, following Section 01255 - Modification Procedures, listing defects and deficiencies discovered, including quantities insufficient to complete work. Do not take receipt of CFP until unsatisfactory conditions are corrected.
  - 1. Repair or replace CFP discovered defective or deficient after receipt by Contractor without change in Contract Sum or Time.
- H. Completely lay CFP out to inspect.
- I. Obtain written receipt or transfer of title from City Engineer.

3.02 INSTALLATION

- A. Install CFP following applicable Sections and Article 3.8 in Document 00700 - General Conditions.

3.03 ATCT RADIO PROCEDURES

- A. ATCT has sole positive authority over radio transmissions on aircraft control frequencies. Do not use ATCT for other than communications with ATCT.
- B. Communicate with ATCT only on City-furnished radios by approved radio operators. Include proper call signs in each communication. Do not change operators without approval.
- C. Communicate with ATCT clearly and legibly in English
- D. Keep ATCT radios turned on and with radio operators and maintain attention to ground control radio traffic while in the AOA. Keep radios in charging bases when not in use.
- E. Obtain ATCT communications protocol and transmission training before preparation of submittal data.
  - 1. ATCT communication with aircraft takes precedence over other Contractor communications.
  - 2. Monitor ATCT transmissions for several hours before attempting to communicate. Train radio operators in proper procedures, frequently monitor radio communication and counsel his personnel on correct procedures.
- F. Delay in ATCT reply may occur. Hold in place until reply is received.

- G. If communication is lost with ATCT, hold in place, or move to a safe area without crossing active runways, taxiways and aprons and reestablish contact.
- H. Turn over ATCT radios, after use is no longer required, to City Engineer following Section 01770 - Contract Closeout.

END OF SECTION

**SECTION 01726**  
**BASE FACILITY SURVEY**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. "Base Facility" is defined in Section 01423 - References.
- B. Survey of Base Facility and related existing conditions.
- C. Notification of discoveries.
- D. Contractor's survey of Base Facility is intended to identify and describe actual as-found conditions to supplement information contained in Base Facility documents and in the Drawings and Specifications.
- E. Necessary changes in location of the Work may be made by City Engineer to avoid unanticipated concealed conditions, following Section 01255 - Modification Procedures.
- F. If permanent relocation or reworking of existing conditions is required and not otherwise provided for in the Contract Documents, City Engineer will direct Contractor following Section 01255 - Modification Procedures.

1.02 BASE FACILITY DOCUMENTS

- A. Drawing and Specifications for the Work are based on City-furnished Base Facility documents and upon the Designer's limited visual observations of sight-exposed conditions existing.
  - 1. Contract Documents do not necessarily completely describe all details of Base Facility at interfaces with the Work.
  - 2. The Designer's observations did not extend to areas or conditions above ceilings or inside partitions and chases.
- B. Obtain available Base Facility documents from the City Engineer.
  - 1. Drawing and Specifications for the Work are based on the City-furnished Base Facility documents and upon limited visual observations of sight-exposed conditions existing at the time of Notice to Proceed (NTP).



**BASE FACILITY SURVEYING**

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2. The contractor will provide HAS with a map of the project area to be used by the infrastructure and IT sections to compile a map of known underground utilities and telecommunications lines and equipment. This process does not replace any base survey methods or requirements.

1.03 SEQUENCING AND SCHEDULING

- A. Sequence and schedule survey to properly coordinate with other construction operations.
- B. Complete survey work, process one or more Document 00685 - Request for Information, obtain responses, evaluate and submit cost or schedule impact of responses, and process accepted modifications before commencing work of affected Sections.
- C. Obtain or designate and protect control samples of Base Facility work during survey and maintain until required submittals pertinent thereto are processed.

1.04 BASE FACILITY CONDITIONS

- A. Base Facility intended or required to remain takes precedence of fact and control over details and construction of interfaces, dimensions, clearances, openings, alignments, and substrate conditions between Base Facility and the Work.
- B. Base Facility is intended to remain except where shown on Drawings or specified as work of Section 01731 - Cutting and Patching or Division 2 sections covering demolition.

1.05 DIMENSIONS

- A. Control dimensions are indicated by nominal value on the Drawings within parenthesis. This designation means, in addition to other requirements, the Contractor is responsible for finding the actual dimension following this Section and using actual dimensions to govern placement of work including relationship to and coordination with related work.
  1. Follow Section 01255 - Modification Procedures to resolve discrepancies between existing conditions and Contract Documents.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. Survey Base Facility affecting or affected by the Work by on-site examination of existing conditions.
- B. Explore ahead of trenching and excavation work to uncover obstructing underground structures sufficiently to determine location, to prevent damage and to prevent interruption

of services. Restore to original condition damages to underground structure at no cost or time increase to the contract, following Section 01731 - Cutting and Patching.

- C. Note discovered discrepancies between the Base Facility and Contract Documents.
  - 1. Use one set of prints of Drawings and Specifications (made from reproducible furnished following Section 01110 - Summary of Work) for the sole purpose of documenting discoveries. Designate as "SURVEY DOCUMENTS."
  - 2. Prepare and issue Document 00685 - Request for Information for each discrepancy, following Section 01255 - Modification Procedures.
  - 3. Supplement data noted on survey documents with video or photographs following Section 01321 - Construction Photographs as required to clearly and fully describe conditions.
- D. Coordinate survey of semi-exposed and concealed conditions with work of Sections 01731-Cutting and Patching.

END OF SECTION

**SECTION 01731**  
**CUTTING AND PATCHING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Obtain CSP and control samples.
- B. Repair remaining Base Facility.
- C. Connect work to Base Facility.
- D. Remove construction required to enable required alteration or addition to Base Facility.
- E. Uncover work for inspection or reinspection of covered work by authorities having jurisdiction.
- F. Connect work not done in proper sequence.
- G. Make connections or alterations to Base Facility or to work.
- H. Provide openings, channels, chases and flues as required.

1.02 SUBMITTALS

- A. Submit Document 00931 - Request for Information, with supporting data, in advance of cutting or patching not shown on the Drawings or which affects:
  - 1. Contract Sum or Time.
  - 2. Visual quality of remaining sight-exposed surfaces exposed after work is complete and for which no work is required other than to gain access.
  - 3. Warrantability, value, integrity, serviceability, or life expectancy of any component of the Base Facility and the Work.
  - 4. Integrity or serviceability of weather-exposed, moisture-resistant, or fire-resistant components or systems.
  - 5. Work outside indicated contract limits.
- B. Include in each request:

1. Identification of the Project.
  2. Description of affected Work.
  3. The necessity for cutting and patching.
  4. Effect on Base Facility construction, on the Work, or on work of separate contractors and work by City.
  5. Description of proposed work:
    - a. Scope of cutting and patching.
    - b. Contractor, Subcontractor or trades executing work.
    - c. Products proposed.
    - d. Extent and type of refinishing.
    - e. Schedule of operations.
  6. Alternatives to cutting and patching, if any.
  7. Written permission of separate contractors or installers of work by City whose work will be affected, countersigned by City Engineer.
- C. Should Base Facility conditions require change of products, follow Section 01630 - Product Options and Substitutions.
- D. Submit product data and samples following Section 01340 - Shop Drawings, Product Data and Samples.
  1. Submit manufacturer's technical literature for each patch material and fully describe compatibility with each substrate.
  2. Submit samples of paint colors and sheen on gypsum board with taped edges.
  3. Submit 2-foot square samples of drywall and plaster finish texture.
  4. Submit mix designs following Section 01455 - City's Acceptance Testing.

E. Submit written notice to City Engineer designating time work will be uncovered for observation. Do not cut until authorized by City Engineer, except when documentable emergency conditions require immediate cutting.

- F. Should conditions of work or schedule indicate change of products or methods, submit Document 00931 - Request for Information stating conditions indicating change, recommendations for alternative products or methods and submittals. Follow Section 01630 - Product Options and Substitutions.

#### 1.03 QUALITY ASSURANCE

- A. Cut and patch by persons qualified to perform work.
- B. Remove minimum construction necessary. Return surfaces to appearance of new work and match Base Facility.
  - 1. Cut finish surfaces such as masonry, tile, plaster or metals in a straight line at a natural line or plane of division from abutting work.
- C. Make patch work visually undetectable at 5-feet for exposed and semi-exposed interior work, and at 10-feet for exposed and semi-exposed exterior work under Base Facility lighting conditions.
- D. Presence of a damaged or defective product, finish or type of construction requires patching, extending or matching be performed as necessary to make work complete and consistent to standards of quality identical to Base Facility.
- E. Promptly notify City Engineer by Document 00931 - Request for Information of discoveries of construction, such as furnishings and articles having possible historic or private value to City.
  - 1. Protect discovery until disposition.
  - 2. Legally dispose of items not removed by City.

#### 1.04 INSPECTION, HANDLING, STORAGE AND PROTECTION OF CSP AND CONTROL SAMPLES

- A. Follow Section 01610 - Basic Product Requirements and following minimum standards.
- B. After removal CSP and control samples, inspect and tag each item. Prepare a written inventory.
  - 1. Describe damage or deficiencies discovered. Process claims and obtain replacement products.
  - 2. Inspect and inventory in presence of City Engineer if necessary.
- C. Store CSP following Section 01610 - Basic Product Requirements until delivery to City. Package CSP in weatherproof containers, labeled with inventory on outside of containers.

- D. Load, transport, off-load and provide other incidental labor required to place CSP inside City's facility. Notify City Engineer at least 7 days before delivery is scheduled.
- E. Provide CSP manufacturer's labor if required to properly handle, store and protect products.
- F. Obtain written receipt or transfer of title from City Engineer.

#### 1.05 SCHEDULING AND SEQUENCING

- A. Provide specific time and date information to City Engineer 48 hours in advance of proposed Work involving temporary shutdown of utilities and environmental systems.
- B. Notify City Engineer at least 7 days before starting work in areas or conditions affecting data, communications, security and paging systems. Do not cut or patch such systems without approval of City Engineer.
- C. Submit a detailed schedule of proposed connections, including shutdowns and tie-ins. Include in the submittal the proposed time and date as well as the anticipated duration of the Work. Submit the detailed schedule coordinated with the construction schedule.

### PART 2 PRODUCTS

#### 2.01 MATERIALS

- A. Based on the Designer's knowledge of available "as-builts" of the Base Facility, and observation of sight-exposed construction, patching materials required include:
  - 1. Concrete Repair: Master Builders "Emaco T430" or substitution following Section 01630- Product Options and Substitutions.
- B. Where there is no specification for a required patch product, provide same products and types of construction as analogous Base Facility construction.
  - 1. Contract Documents do not define products or standards of quality present in the Base Facility.
  - 2. Determine products required following Section 01726 - Base Facility Survey. Determine required workmanship by using equivalent Base Facility products as control samples.

### PART 3 EXECUTION

#### 3.01 GENERAL PERFORMANCE

- A. In addition to demolition work, cut, move or remove discovered non-hazardous-material Base Facility items as necessary to provide access or to allow alterations and new work to proceed, as approved or directed, including:
  - 1. Repair or remove dangerous and unsanitary conditions.
  - 2. Remove abandoned items and items serving no useful purpose, such as Base Facility abandoned HVAC components, piping, data cables, conduit and wiring back to panels, and ductwork.
    - a. Confirm abandonment with City Engineer prior to removal.
  - 3. Remove unsuitable or extraneous products not designated for salvage, such as abandoned furnishings and equipment, and debris such as rotted wood, rusted metals and deteriorated concrete.
- B. Patch, repair and refinish Base Facility items intended or designated to remain, to match analogous Base Facility conditions for each product, with proper transition between new work and Base Facility.
- C. Remove and replace defective or deficient new work and work not following Contract Documents.
- D. Remove samples of Base Facility and work for Contractor's surveillance testing and for tests in Section 01455 - City's Acceptance Testing.
- E. Provide routine penetrations and applicable fire-rated or weather-resistant separations for plumbing piping, electrical conduit, HVAC ducts, and similar items required to complete the work, including incidental conditions occurring outside the indicated contract limits, which occur in walls, floors, ceilings, partitions and roofs.
- F. Repair damage to Base Facility resulting from work under this contract.
- G. Perform activities to avoid interference with facility operations and work of other contractors, following Document 00700 - General Conditions and Sections 01145 - Use of Premises, 01312 - Coordination and Meetings, 01505 - Temporary Facilities and 01506 - Temporary Controls.
- H. Restore Base Facility to a state equivalent to or better than that before cutting and patching. Restore new work to standards of these Specifications.
- I. Support, anchor, attach, match, trim and seal materials to work of other contractors. Unless otherwise specified, provide sleeves, inserts, and hangers, required for the execution of the Work.

- J. Provide shoring, bracing and support as required to maintain structural integrity and protect adjacent work from damage during cutting and patching. Before cutting beams or other structural members, anchors, lintels or other supports, request written instructions from City Engineer. Follow such instructions, as applicable.
  - K. Cut and patch as recommended by manufacturers of patch products, and where possible by manufacturer of affected Base Facility products.
  - L. Fit and adjust products to provide finished installation complying with specified products, functions, tolerances and finishes.
  - M. Restore Base Facility damaged as a result of the Work. Install work following Contract Documents, Base Facility documents, trade standards, or governing agencies, as applicable.
    - 1. Follow Section 01726 - Base Facility Survey to document Base Facility damage Base Facility prior to commencing work.
  - N. Refinish entire exposed and semi-exposed surfaces.
    - 1. For continuous surfaces, refinish to nearest change in plane. Remove and reinstall remaining signs, hardware and similar interferences.
    - 2. For an assembly, refinish entire unit.
  - O. Where cutting and patching fails to match Base Facility work, provide complete replacement work.
- 3.02 TEMPORARY FACILITIES AND PROTECTION
- A. Follow Section 01505 - Temporary Facilities.
- 3.03 INSPECTION AND COORDINATION
- A. Inspect Base Facility following Section 01726 - Base Facility Survey, and if required provide Contractor's testing following Section 01450 - Contractor's Quality Control, for Base Facility conditions subject to this Section.
  - B. Report by Document 00931 - Request for Information Questionable Base Facility conditions that affect the Work.
  - C. Obtain written authorizations before beginning utility or environmental systems work affecting Base Facility outside the contract limits.
- 3.04 REMAINING FLOORS, WALLS, CEILINGS AND DOORWAYS



A. Where only partitions are removed, patch remaining floors, walls and ceilings, with substrate and finish materials to match Base Facility.

1. Where removal of partitions results in adjacent spaces becoming one, rework floors and remaining walls and ceilings to provide smooth planes without breaks, steps or bulkheads.
2. Where extreme change of plane occurs, obtain direction by Document 00931 - Request for Information.

B. Trim and refinish Base Facility doors as necessary to clear plane of new floors.

### 3.05 DAMAGED SURFACES

A. Replace or patch any portion surfaces of the Work and Base Facility found damaged, lifted, discolored, or showing other imperfections resulting from work, with matching sound material and finish.

1. Provide proper support of substrate before patching.
2. Refinish patched portions of painted or coated surfaces scheduled for new finish, to produce uniform color and texture over entire surface.
  - a. Tape, float, sand and apply two coats of latex paint to repaired Base Facility drywall, plaster, doors and doorframes.
3. Exceptions: Fully patch remaining Base Facility surfaces exposed and semi-exposed to public view to match all visual characteristics of Base Facility.

### 3.06 TRANSITION FROM BASE FACILITY TO NEW CONSTRUCTION

A. Where new work abuts or finishes against Base Facility work, make smooth and workmanlike transition. Match patched work adjacent to Base Facility work for all visual characteristics.

1. Where smooth transition is not possible, terminate Base Facility surface neatly along a straight line at a natural line or plane of division, and provide edge trim appropriate to substrate and finish.
2. Exceptions: Fully patch remaining Base Facility surfaces exposed and semi-exposed to public view to match all visual characteristics of Base Facility.

### 3.07 SITE UTILITY AND BUILDING ENVIRONMENTAL SYSTEMS

- A. Perform work needed to complete connections and tie-ins to Base Facility. Keep Base Facility in continuous operation unless otherwise specifically permitted or approved by City Engineer.
- B. Base Facility electrical and mechanical systems and site utilities are intended to be functioning properly prior to start of the Work. Follow Section 01505 to confirm proper function.
  - 1. Notify City Engineer by Document 00931 - Request for Information of non-operating systems prior to commencing affected work in each area.
  - 2. Do not proceed with work affecting improperly functioning utilities or systems until corrective work is complete.
- C. Make required cuts, plugs and terminations. Tag remaining lines with contents names and direction of flow, whether or not flow is active, using weather-resistant tags and permanent markers.
- D. Plumbing Systems and HVAC Systems:
  - 1. Provide temporary or permanent by-passes, test plugs and stop valves in plumbing waste and supply lines, and in HVAC system piping as individual fixtures and equipment are removed. Do not bypass wastewater or sludge into waterways. Provide temporary pumping facilities to handle wastewater if necessary. Provide temporary power supply and piping to facilitate construction where necessary.
    - a. Scope, type and locations of temporary plugs and valves are at the Contractor's option, as approved, based on Base Facility conditions encountered.
    - b. Unless otherwise required, install permanent plugs and valves as follows:
      - 1) For risers tapped into remaining lateral lines cut and plug risers as close as practical to laterals.
      - 2) For laterals, cut and plug approximately one foot from surface of Base Facility demising walls intended to remain.
      - 3) For risers extending through floors in unoccupied areas, cut and plug approximately one foot above top surface of Base Facility floor.
      - 4) For risers extending through floors in occupied areas and which cannot be fully removed following Paragraph 1) above, cut and plug flush with surface of Base Facility floor.
- E. Electrical Power Systems:

1. Provide temporary or permanent bypasses and terminations of electrical systems. Do no work on Base Facility data, communications, security or paging systems following Paragraph 1.05.B above.
    - a. Scope, type and location of terminations are at the Contractor's option, as approved, determined by Base Facility conditions encountered.
    - b. Unless otherwise required, terminate electrical lines as follows:
      - 1) For circuits tapped into remaining laterals intended to remain and which occur above Base Facility ceiling planes, terminate circuits in approximately sized junction boxes as close as practical to the lateral. Attach boxes to building structure, install wire nuts on unconnected wires, and permanently label outside of box with panel/circuit number and voltage.
      - 2) For abandoned circuits, remove wire, conduit, boxes, breakers and related components back to the respective panel boxes or terminal boards, and provide a blank plate in the breaker slot, and identify plate as "SPARE CIRCUIT/ (CAPACITY) AMP" minimum.
    - c. Unless otherwise required by demolition work, and where Base Facility ceilings are indicated for removal, leave paging and security system components in place, using at least two hanger wires per device.
  2. Provide permanent support for risers and laterals intended to remain.
  3. Fit ductwork, conduit and pipes water-tight, air-tight and fire-stopped at penetrations through walls, floors and ceiling, whether or not Base Facility penetrations are constructed as water-, air- or fire-tight.
    - a. If not otherwise shown on Drawings, provide properly sized fire dampers for remaining Base Facility ducts which penetrate fire-rated construction, and which do not already have fire dampers.
- F. Insofar as possible, test work under operating conditions before final tie-ins are made to connect equipment to the Base Facility. Test remaining utilities and service in presence of City Engineer before covering up. Repair defects and deficiencies.

### 3.17 INTERIM CLEANING

- A. Clean occupied areas daily. Immediately remove spillage, overspray, dust and debris in occupied areas and at points of access into contract limits. Sweep and wet mop floors as required, using safety cones and tape barricades as required cleaning operations.

- B. Make surfaces ready for work of successive trades.
- C. At completion of work in each area, provide final cleaning following Section 01770 - Contract Closeout.

END OF SECTION

**SECTION 01761**  
**PROTECTION OF EXISTING SERVICES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements to protect existing services and minimize impact of interruptions.

1.02 DEFINITIONS:

- A. Service is defined to include utilities (natural gas, water, or power); lighting and emergency lighting; data and telecommunications; closed-circuit video, control and monitoring circuits, and air conditioning, heating, and ventilating. Service types include:
  - 1. Power.
  - 2. Lighting, and emergency lighting.
  - 3. Paging.
  - 4. Telephone.
  - 5. Video.
  - 6. Data and computer networks.
  - 7. Water.
  - 8. Natural gas.
  - 9. Heating, ventilating, and air conditioning
- B. Data and Telecom Service is defined to include:
  - 1. Wiring and cable used for the transmission of data, voice, or video information.
  - 2. Wiring for low voltage monitoring and control of various types of devices.
- C. Service interruption is defined to include any temporary or permanent inability to provide the service as contracted or as intended and includes interference with or disruption to source, distribution, or terminal items of a service system.

**PROTECTION OF EXISTING SERVICES**

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- D. Response time is defined to be the time elapsed between the time that a Service Interruption becomes known to the Contractor and the time that a person is at the site of the interruption or, if the site of the interruption is not immediately known, at the job site to diagnose and locate the service interruption.

1.03 PERFORMANCE REQUIREMENTS

- A. Contractor is required to protect and maintain existing services to those operating areas of the Airport.
  - 1. Where services are affected by construction activities and interruption of service is required to complete the Work, schedule service interruption to minimize impact.
  - 2. Where services cannot be interrupted, provide alternate services or circuits as required to maintain affected services. Design and implement service "cut-over" so that services are maintained without interruption.
- B. Train employees and subcontractors to ensure that accidental service interruptions are promptly recognized, and appropriate responses can be initiated.
- C. Maintain personnel, equipment, and parts at hand or on call to provide the response times indicated.
- D. Interruptions to Existing Service are classified as follows:
  - 1. Security Service Interruption:
    - a. Any service interruption of power, lighting, or data and telecom service that affects and compromises one of the following:
      - (1) FAA Security
      - (2) Airline Security
      - (3) Airport Security
      - (4) Other government entity charged with enforcing security at the Airport (Houston Police Department, FBI, Secret Service, etc.).
    - b. Security Services must be active at all times.
  - 2. Life Safety Service Interruption:
    - a. Any service interruption of power, lighting, or data and telecom service affecting or compromising one or more of the following life safety systems.

**PROTECTION OF EXISTING SERVICES**

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- (1) Fire/smoke alarms.
- (2) Emergency lighting.
- (3) Elevator operations in "Fire" mode.
- (4) Emergency intercom systems.

b. Life Safety Services must be active at all times.

3. Business Service Interruption:

a. Any service interruption of utility service (power, lighting, natural gas, data and telecom, etc.) that affects and compromises the ability of a profit-seeking entity to earn revenue, including:

- (1) Airline: Includes FIDS network, reservation/confirmation systems, paging systems.
- (2) Tenants Other Than Airlines: Point of sale systems, reservation/confirmation systems, utilities for storing, cooking, or maintaining food for sale to the public.

b. Business Services must be active at all times in the areas of the Airport served by Airlines or other tenants during hours of their operation.

4. Comfort / Convenience Service Interruption :

a. Any service interruption of power, lighting, or data and telecom services affecting or compromising the comfort or convenience of those using the Airport (passengers, visitors, employees, concessionaires, etc.) including:

- (1) Lighting.
- (2) Air Conditioning.
- (3) Heating.
- (4) Public telephones.
- (5) Elevators.

b. Minimize Comfort/Convenience Service Interruptions except in construction areas.

1.04 SUBMITTALS

A. Schedule of service interruptions.

**PROTECTION OF EXISTING SERVICES**

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- B. Emergency Response Plan.

1.05 QUALITY ASSURANCE

- A. Develop emergency response plan for each class of service interruption indicated. Notify other contractors responsible for services and obtain contact information. Where possible, obtain written instructions for emergency repairs from the contractor responsible for each service. Where required, arrange for contractor personnel to be available to meet required response times.

1.06 COORDINATION AND SEQUENCING

- A. Schedule and execute construction activities to prevent service interruption or, where service interruption is required to complete the Work, minimize service interruption.

1.07 SCHEDULING

- A. Follow Section 01325.
- B. Develop a schedule of required service interruptions. Coordinate with the schedules required by Section 01325 and revise as required by the City or project conditions.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CONTRACTOR RESPONSIBILITIES:

- A. Follow Section 01726.
- B. Scheduled Service Interruptions: Notify the City Engineer in writing not less than 7 days in advance of a scheduled service interruption. In notifying of the Scheduled Service Interruptions, click on the weblink [\[Work Area Notification \(WAN\) form\]](#) and review the checklist. At the bottom of the checklist, check the box confirming attendance of the Contractor Safety Requirement meeting, and Contractor and all Subcontractors understands and will comply with all Houston Airport System (HAS) and OSHA requirements.
- C. Complete a Work Area Notification form by clicking on the weblink [\[Work Area Notification \(WAN\) form\]](#) for any/all service interruptions and/or; for,
- D. Unscheduled Service Interruptions to Data and Telecom Service:



**PROTECTION OF EXISTING SERVICES**

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1. *Immediately notify IAH 24-Hour Emergency Dispatch Service at (281) 230-3024 [HOU 24-Hour Emergency Dispatch Service at (713) 641-4000; (after hours call: 713-847-4200)]. Do not attempt to repair these lines. Include the following information:*
    - a. Location.
    - b. Area(s) affected.
    - c. Type and classification of service (if known).
    - d. Entities affected (if known).
  2. In addition to the notification requirements above, immediately notify the City Engineer of interruption.
- E. **Unscheduled Service Interruptions to Service Other Than Data and Telecom Service:**
1. When executing Work in an area known to have existing services, maintain on-site or on-call capability to initiate repairs to unscheduled service interruptions within the response times required.
  2. Immediately notify the City Engineer of interruption.
    - a. Location.
    - b. Area(s) affected.
    - c. Type and classification of service (if known).
    - d. Entities affected (if known).
  3. **Response Times to Interruptions to Existing Service:**
    - a. Security Service Interruption: 15 minutes.
    - b. Life Safety Service Interruption: 15 minutes.
    - c. Business Service Interruption:
      - (1) Service Interruptions to Airlines: 15 minutes.
      - (2) Service Interruptions to Tenants other than Airlines: 1 hour.
    - d. Comfort/Convenience Service Interruption: 1 hour.

END OF SECTION

**SECTION 01770**  
**CONTRACT CLOSEOUT**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Submittal of Operation and Maintenance (O & M) manual, lien releases, record documents, badges, and keys.
- B. O & M manual format and contents.
- C. Final cleaning. Interim cleaning is specified in Section 01505.
- D. Systems demonstrations and personnel training.
- E. Notification of Substantial Completion.
- F. Contractor's punch list.
- G. Record of the Work.
- H. Forwarding of Contractor-Salvaged products (CSP), and extra products.

1.02 SUBMITTALS

- A. Two weeks before Substantial Completion inspection, submit 2 sets of Preliminary O & M manual (Paragraph 1.03), 1 copy to Designer and 1 copy direct to City Engineer.
- B. Subsequent to Preliminary O & M manual submittal and precedent to final Certificate for Payment, submit the following:
  - 1. The Contractor shall submit Preliminary O&M Manuals to the City for review and acceptance a minimum of 60 calendar days prior to starting the commissioning process.
  - 2. Release or Waiver of Liens and consents of sureties following Documents 00700-General Conditions and 00800 - Supplementary Conditions.
  - 3. BIM As-Built and BIM Record Documents
    - a. Provide the final coordinated trade construction as-built and/or fabrication models in native format, to the City at regular intervals at the end of the Construction Phase that will have incorporated all addenda, approved Change Orders, and the

modifications and deliver the final record model to the City as part of the project close-out documents.

- b. The format of the delivered documents shall consist of:
    - 1) PDF files of drawings and specifications.
    - 2) HAS approved AutoCAD version of drawings.
    - 3) Native formats of the BIM model including HAS approved Revit version.
    - 4) HAS approved version of Navisworks files and Civi3D
    - 5) All information, drawings and manuals should conform with HAS approved BIM standards and BPxP.
  - 4. File organization, File directory structure, Sheet Borders, titles, method of delivery and other specifications should be in conform to HAS CAD/GIS Data Standards and HAS BIM Standards, available in [www.fly2houston.com/tip](http://www.fly2houston.com/tip).
  - 5. Security identification badges.
  - 6. Construction and other master keys.
- 1.03 O&M MANUAL CONTENTS AND FORMAT
- A. Provide O & M Manual with full information to allow matching products under future contracts to products under this contract, and to allow City to operate, maintain and repair (for user-serviceable aspects) products, including trade names, model or type numbers, colors dimensions, and other physical characteristics.
  - B. Electronic Format:
    - 1. Submit in searchable PDF to reflect 8.5” x 11” inch page and margins shall be formatted for double-sided print out or copy. Large format shall be pre-approved by the City.2. Sections within the O & M Manual shall also be formatted to reflect dividers if a printout copy is desired.3. Cover of the O& M Manual shall be titled “OPERATION AND MAINTENANCE MANUAL, title of project and subject matter and “Number \_ of \_ if multiple volumes are developed. Include the City’s Project Number and AIP/CIP Number.
  - C. Contents:
    - 1. Table of Contents for each volume, naming each Part.

2. Part 1: Directory with name, address, and telephone number of Designer, Contractor, and Subcontractors and Suppliers for each Project Manual Section.
3. Part 2: Operation and maintenance instructions, arranged by Project Manual Section number where practical, and where not, by system. Include:
  - a. For finish materials, maintenance instructions prepared by manufacturers, including recommended cleaning methods and materials and special precautions identifying detrimental agents.
  - b. Utility, door and window hardware, HVAC, plumbing and electrical products, prepared by product manufacturer, including:
    - 1) Product design criteria, functions, normal operating characteristics, and limiting conditions.
    - 2) Assembly, installation, alignment, adjustment, checking instructions, and troubleshooting guide.
    - 3) Operating instructions for start-up, normal operation, regulation and control, normal shutdown, and emergency shutdown.
    - 4) Lubrication and detailed maintenance instructions; detailed drawings giving location of each maintainable part and lubrication point and detailed instructions on disassembly and reassembly of products.
    - 5) Spare parts list for operating products, prepared by manufacturers, including detailed drawings giving location of each maintainable part; describe predicted life of parts subject to wear, lists of spares recommended for user-service inventory, and nearest source of in-stock spares.
    - 6) Outline, cross-section, and assembly drawings; engineering data; wiring diagrams.
    - 7) Test data and performance curves.
4. Part 3: Project documents and certificates, including:
  - a. Shop drawings, product data, and where practical, samples.
  - b. Air and water balance reports.
  - c. Certificates of occupancy or use.
  - d. Product certifications and mix designs.

- e. Material Safety Data Sheets.
  - 5. Part 4: Copy (not original) of each warranty form containing language of final warranty.
  - 6. Part 5: Meeting notes from systems demonstrations.
  - 7. Revise content and arrangement of preliminary Manual until approval by City Engineer.
- 1.04 FINAL CLEANING
- A. Execute final cleaning prior to Substantial Completion [of each Stage].
  - B. Clean surfaces exposed to view; remove temporary labels and protective coverings, stains and foreign substances; polish transparent and glossy surfaces; vacuum carpeted and soft surfaces. Clean equipment and fixtures to sanitary condition. Clean permanent filters and install new replaceable filters at equipment. Clean HVAC diffusers.
  - C. Remove and legally dispose of waste and surplus products and rubbish, including from roofs, gutters, downspouts, drainage systems, pavements, lawn and landscaped areas, and elsewhere from site.
  - D. Sweep streets and parking areas, rake lawn and landscaped areas.
  - E. Wash roofs, opaque building walls and sidewalks.
  - F. Remove temporary facilities and controls.
  - G. Leave premises in spotless condition, requiring no further cleaning of construction by City.
  - H. Adjust products to proper operating condition.
  - I. Correct defective function of products.
- 1.05 SYSTEMS DEMONSTRATIONS AND PERSONNEL TRAINING
- A. Demonstrate proper operation and maintenance of each product to City's maintenance personnel precedent to Substantial Completion inspection.
    - 1. Operate HVAC, plumbing, and electrical systems 7 continuous days precedent to personnel training.
  - B. Precedent to submittal of O & M Manual, train City's maintenance personnel in proper operation, adjustment, and maintenance of products and systems, using the preliminary O

& M Manual as the basis of instruction. Continue training until City's personnel demonstrate proper knowledge and skills.

- C. Take minutes of meetings, including sign-in sheet, and record subjects covered in each session. Bind minutes in O&M Manual.

#### 1.06 NOTIFICATION OF SUBSTANTIAL COMPLETION

- A. When Contractor considers the Work (or a designated portion or stage thereof identified in Section 01326 - Construction Sequencing) substantially complete, submit written notice and Punchlist (Paragraph 1.04) to City Engineer.

- 1. Do not claim Substantial Completion until authorities having jurisdiction issue certificates of occupancy or use and related inspections affirming compliance.
- 2. Attach copy of each certificate to Substantial Completion form.

- B. Within a reasonable time after receipt of certificates, an inspection will be made by City Engineer and Designer to determine status of completion.

- C. Should the Work be determined by City Engineer as not substantially complete as a result of any Substantial Completion inspection, Contractor will be notified in writing.

- 1. Remedy deficiencies.
- 2. Send written notice of Substantial Completion as above.
- 3. City Engineer and Designer will reinspect the Work.
- 4. Pay costs of Designer's second and subsequent Substantial Completion inspections, by Change Order.

- D. When the Work is determined as substantially complete, the Certificate of Substantial Completion will be executed.

#### 1.07 CONTRACTOR'S PUNCHLIST

- A. Prior to and in connection with Substantial Completion procedures, prepare a written Punchlist on a [room-by-room] [area-by-area] basis [for each stage] and as follows:

- 1. Designer will provide one reproducible copy of then-current floor plans. These drawings are the basis of Contractor's Punchlist.
- 2. Inspect the Work and mark applicable comments on the floor plans. Prepare written notes as required to supplement notes made on drawings.

3. Continue completion of the Work including Punchlist items, marking off completed items.
  4. Forward 3 diazo prints of the annotated Drawings to City Engineer accompanied by notification that Substantial Completion Inspection is ready.
- B. Schedule Punchlist Inspection and other closeout inspections through City Engineer.
- C. Punchlist inspection will be attended by the following as a minimum:
1. Contractor, Contractor's Superintendent, and applicable Subcontractors' superintendents. Attend with Punchlist drawing.
  2. City Engineer.
  3. Designer.
  4. Others of City Engineer's choice.
- D. Substantial Completion inspection will be made during one or more mutually agreed times to inspect the Work, to review and amend Contractor's Punchlist. If the work is substantially complete, Document 00645 - Certificate of Substantial Completion will be executed.
1. Amendments to the Contractor's Punchlist will be made on the reproducible.
  2. Within 5 days of execution of Document 00645, provide 4 copies of the amended Punch List and original Document 00645 to City Engineer.
- E. Expediently correct work.
- F. Process each reinspection as above and in Paragraph 1.04.
- G. Punchlist items and corrections required after execution of Document 00650 - Certificate of Final Completion will be processed as warranty work following Document 00700 - General Conditions, Paragraph 3.12.
- 1.08 RECORD OF THE WORK
- A. Following requirements expand Paragraph 3.16 of Documents 00700 - General Conditions and 00800 - Supplementary Conditions.
  - B. Record information concurrently with construction progress. Do not conceal work until required information is recorded.
  - C. Keep in a secure location at the Contractor's office and timely record the Work as actually built as the Work progresses.

1. Contractor shall maintain one full size set of Construction Documents and one set of the Project Manual(s) in the Contractor's Field office. In addition, the Contractor shall maintain one record set of submittal data, video and photographic data, and other record data as required by to support and supplement record changes made on Drawings and the Project Manual(s).
  2. Legibly note variations from Contract Documents on Drawings, Project Manual and submittal data, whichever most clearly shows the change.
  3. Clearly mark each document in red ink "RECORD OF THE WORK. Use only for recording field deviations and actual constructed conditions and arrangements."
- D. Keep documents current and make available for inspection by City Engineer.
- E. Show following minimum information, as applicable to type of work, marked in fine-point red ink:
1. Measured depths of foundation elements in relation to finish first floor datum.
  2. Measured horizontal locations and elevations of underground utilities and appurtenances, referenced to permanent surface improvements.
  3. Elevations of underground utilities referenced to City's benchmark utilized for project.
  4. Measured locations of internal utilities, environmental systems and appurtenances concealed in construction, referenced to visible and accessible features of construction.
  5. Field changes of dimension and detail.
  6. Changes made by RFI (Document 00931).
  7. Changes made by Modifications.
  8. Details not on original Contract Documents.
  9. References to related shop drawings, product data, samples, RFIs and Modifications.
- F. Upon completion of the Work, collect diazo prints of marked-up Drawings, one single-sided copy of marked-up Project Manual, one set of shop drawings (including diskettes of CADD files prepared as part of the Contract, such as data required by Section 01340- Shop Drawings, Product Data and Samples), one original set of product data (Section 01340), one set of RFIs, one set of Modifications, one set of originals of video tapes and one copy of photographs (Section 01321 - Construction Photographs), and other required documents.
1. Clearly mark each document, immediately adjacent to the "RECORD OF THE WORK" mark, in red ink thus:



“CERTIFIED AS THE CORRECT AND COMPLETE RECORD OF WORK PERFORMED.

\_\_\_\_\_ (Contractor Firm Name)  
\_\_\_\_\_ (Authorized Signature)  
\_\_\_\_\_ (Date)

- G. Transmit all records to City Engineer.
- H. Transmit reproducible copies of Drawings (see Section 01110 - Summary of Work) to City Engineer.
- I. Submit proper record of the Work, in addition to other requirements in the Contract Documents, precedent to City Engineer’s authorization for release of final payment.

1.09 FORWARDING CSP AND EXTRA PRODUCTS

- A. Before submitting final application for payment, forward remaining proper CSP (Section 01110 - Summary of Work), extra products, including spare parts (specified in other Sections) to location designated by City Engineer.
- B. Furnish pallets and containers as required for proper product storage.
- C. Unload products from Contractor’s vehicles. Place pallets, containers and products as directed by City Engineer.
- D. Obtain written transfer of title or receipt.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**OPERATIONS AND MAINTENANCE DATA**

**SECTION 01782**

**OPERATIONS AND MAINTENANCE DATA**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Submittal requirements for equipment and facility Operations and Maintenance (O&M) Manuals

1.02 MEASUREMENT AND PAYMENT

- A. Measurement for equipment O&M Manuals is on a lump sum basis equal to five percent of the individual equipment value contained in Schedule of Unit Prices or Schedule of Values. The lump sum amount may be included in the first Progress Payment following approval of the O&M Manuals by Project Manager.

1.03 SUBMITTALS

- A. Conform to requirements of Section 01330 - Submittal Procedures. Submit a list of O&M Manuals and parts manuals for equipment to be incorporated into the Work.
- B. Submit documents with 8-1/2 x 11-inch text pages, bound in 3-ring/D binders with durable plastic covers.
- C. Print "OPERATION AND MAINTENANCE INSTRUCTIONS", Project name, and subject matter of binder on covers when multiple binders are required.
- D. Subdivide contents with permanent page dividers, logically organized according to the Table of Contents, with tab titling clearly printed under reinforced laminated plastic tabs.
- E. O&M Manual contents: Prepare a Table of Contents for each volume, with each Product or system description identified.
  - 1. Part 1 - Directory: Listing of names, addresses, and telephone numbers of Design Consultant, Contractor, Subcontractors, and major equipment Suppliers.
  - 2. Part 2 - O&M instructions arranged by system. For each category, identify names, addresses, and telephone numbers of Subcontractors and Suppliers and include the following:
    - a. Significant design criteria.
    - b. List of equipment.
    - c. Parts list for each component.

**OPERATIONS AND MAINTENANCE DATA**

- d. Operating instructions.
  - e. Maintenance instructions for equipment and systems.
  - f. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.
3. Part 3 -Project documents and certificates including:
- a. Shop Drawings and relevant data.
  - b. Air and water balance reports.
  - c. Certificates.
  - d. Photocopies of warranties.
- F. Submit two copies of O&M Manuals and parts manuals, for review, within one month prior to placing the equipment or facility in service.
- G. Submit one copy of completed volumes in final form 10 days prior to final inspection. One copy with Project Manager comments will be returned after final inspection. Revise content of documents based on Project Manager's comments prior to final submittal.
- H. Revise and resubmit three final volumes within 10 days after final inspection.

1.04 EQUIPMENT O&M DATA

- A. Furnish O&M Manuals prepared by manufacturers for all equipment. Manuals must contain, as a minimum, the following:
1. Equipment functions, normal operating characteristics, and limiting conditions.
  2. Assembly, Installation, alignment, adjustment, and checking instructions.
  3. Operating instructions for start-up, normal operation, regulation and control, normal shutdown, and emergency shutdown.
  4. Detailed drawings showing the location of each maintainable part and lubrication point with detailed instructions on disassembly and reassembly of the equipment.
  5. Troubleshooting guide.
6. Spare parts list, predicted life of parts subject to wear, lists of spare parts recommended to be on hand for both initial start-up and for normal operating inventory, and local or nearest source of spare parts availability.

**OPERATIONS AND MAINTENANCE DATA**

7. Outline, cross-section, and assembly drawings with engineering data and wiring diagrams.
  8. Test data and performance curves.
- B. Furnish parts manuals for all equipment, prepared by the equipment manufacturer, which contain, as a minimum, the following:
1. Detailed drawings giving the location of each maintainable part.
  2. Spare parts list with predicted life of parts subject to wear, lists of spare parts recommended on hand for both initial start-up and for normal operating inventory, and local or nearest source of spare parts availability.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01785**  
**PROJECT RECORD DOCUMENTS**

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Maintenance and submittal of record documents and Samples.

1.02 MAINTENANCE OF DOCUMENTS AND SAMPLES

- A. Maintain one record copy of documents at the site in accordance with Document 00700 - General Conditions,
- B. Store record documents and Samples in field office, if a field office is required by the Contract, or in a secure location. Provide files, racks, and secure storage for record documents and Samples.
- C. Label each document "PROJECT RECORD" in neat, large, printed letters.
- D. Maintain record documents in a clean, dry, and legible condition. Do not use record documents for construction purposes. Do not use permit drawings to record Modifications to the Work.
- E. Keep record documents and Samples available for inspection by Project Manager.
- F. Bring record documents to progress review meetings for viewing by Project Manager and, if applicable, Design Consultant.

1.03 RECORDING

- A. Record information legibly with red ink pen on a set of blue-line opaque drawings, concurrently with construction progress. Maintain an instrument on site at all times for measuring elevations accurately. Do not conceal work until required information is recorded
- B. Contract Drawings and Shop Drawings: Mark each item to record completed Modifications, or when minor deviations exist, the actual construction including:
  - 1. Measured depths of elements of foundation in relation to finish first floor datum.
  - 2. Measured horizontal locations and elevations of Underground Facilities and appurtenances, referenced to permanent surface improvements.
  - 3. Elevations of Underground Facilities referenced to City of Houston benchmark utilized for the Work.
  - 4. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.

5. Dimensions and details of field changes.
  6. Changes made by Modifications.
  7. Details not on original Drawings.
  8. References to related Shop Drawings and Modifications.
- C. Survey all joints of water mains at the time of construction. Record on Drawings, water main invert elevation, elevation top of manway, and centerline horizontal location relative to baseline.
- D. For large diameter water mains, mark specifications and addenda to record:
1. Manufacturer, trade name, catalog number and Supplier of each Product actually installed.
  2. Changes made by Modification or field order.
  3. Other matters not originally specified.
- E. Annotate Shop Drawings to record changes made after review.

#### 1.04 SUBMITTALS

- A. At closeout of the Contract, deliver Project record documents to Project Manager.

#### PART 2 PRODUCTS (NOT USED)

#### PART 3 EXECUTION (NOT USED)

END OF SECTION

## SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

### 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. Manufactured Products:
    - a. Manufactured reglets and counterflashing.
  - 2. Formed Products:
    - a. Formed wall sheet metal fabrications.
    - b. Formed equipment support flashing.
- B. Related Sections:
  - 1.
  - 2. Section 07 92 00 "Joint Sealants".

#### 1.3 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Fabricate and install copings capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49:
  - 1. Wind Zone 1: For velocity pressures of 10 to 20 lbf/sq. ft.: 40-lbf/sq. ft. perimeter uplift force, 60-lbf/sq. ft. corner uplift force, and 20-lbf/sq. ft. outward force.
  - 2. Wind Zone 1: For velocity pressures of 21 to 30 lbf/sq. ft.: 60-lbf/sq. ft. perimeter uplift force, 90-lbf/sq. ft. corner uplift force, and 30-lbf/sq. ft. outward force.
  - 3. Wind Zone 2: For velocity pressures of 31 to 45 lbf/sq. ft.: 90-lbf/sq. ft. perimeter uplift force, 120-lbf/sq. ft. corner uplift force, and 45-lbf/sq. ft. outward force.
  - 4. Wind Zone 3: For velocity pressures of 46 to 104 lbf/sq. ft.: 208-lbf/sq. ft. perimeter uplift force, 312-lbf/sq. ft. corner uplift force, and 104-lbf/sq. ft. outward force.

- C. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:
  - 1. Identification of material, thickness, weight, and finish for each item and location in Project.
  - 2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
  - 3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
  - 4. Details of termination points and assemblies, including fixed points.
  - 5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.
  - 6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
  - 7. Details of special conditions.
  - 8. Details of connections to adjoining work.
- 9. Detail formed flashing and trim at a scale of not less than 1-1/2 inches per 12 inches.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
  - 1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
  - 2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.
  - 3. Accessories and Miscellaneous Materials: Full-size Sample.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified fabricator.
- B. Warranty: Sample of special warranty.

#### **1.6 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.



## **1.7 QUALITY ASSURANCE**

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
- B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.
- C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
  - 1. Build mockup of typical roof eave, including built-in gutter, fascia, fascia trim, and apron flashing, approximately 10 feet long, including supporting construction cleats, seams, attachments, underlayment, and accessories.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Preinstallation Conference: Conduct conference at Project site.
  - 1. Meet with Owner, Architect, Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
  - 2. Review methods and procedures related to sheet metal flashing and trim.
  - 3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
  - 4. Review special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect sheet metal flashing.
  - 5. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

## **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

## **1.9 WARRANTY**

- A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows 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, checking, 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 SHEET METALS**

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.
  1. Exposed Coil-Coated Finishes:
    - a. Three-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent 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.
  2. Color: Match existing flashing.
  3. Concealed Finish: Pretreat with 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.
- C. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed.
  1. Finish: 2D (dull, cold rolled).
  2. Surface: Smooth, flat.

### **2.2 UNDERLAYMENT MATERIALS**

- A. Polyethylene Sheet: 6-mil- thick polyethylene sheet complying with ASTM D 4397.
- B. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
- C. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
  1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F.
  2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F.

3. Products: Subject to compliance with requirements, provide one of the following:
  - a. Carlisle Coatings & Waterproofing Inc.; CCW WIP 300HT.
  - b. Grace Construction Products, a unit of W. R. Grace & Co.; Ultra.
  - c. Henry Company; Blueskin PE200 HT.
- D. Slip Sheet: Building paper, 3-lb/100 sq. ft. minimum, rosin sized.

### 2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
  1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
    - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
    - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
    - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
  2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
  3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
- C. Solder:
  1. For Stainless Steel: ASTM B 32, Grade Sn60, with an acid flux of type recommended by stainless-steel sheet manufacturer.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- E. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

## 2.4 MANUFACTURED SHEET METAL FLASHING AND TRIM

- A. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with interlocking counterflashing on exterior face, of same metal as reglet.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Cheney Flashing Company.
    - b. Fry Reglet Corporation.
    - c. Heckmann Building Products Inc.
    - d. Hickman, W. P. Company.
    - e. Hohmann & Barnard, Inc.; STF Sawtooth Flashing.
    - f. Keystone Flashing Company, Inc.
    - g. National Sheet Metal Systems, Inc.
    - h. Sandell Manufacturing Company, Inc.
  2. Material: Stainless steel, 0.019 inch thick.
  3. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
  4. Accessories:
    - a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
    - b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.
  5. Finish: Mill.

## 2.5 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
  2. Obtain field measurements for accurate fit before shop fabrication.
  3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
  4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a 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.

- C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."
- D. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant.
- E. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
- F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- G. Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" and by FMG Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.
- H. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
- I. Do not use graphite pencils to mark metal surfaces.

## **2.6 ROOF DRAINAGE SHEET METAL FABRICATIONS**

- A. Built-in Gutters: Fabricate to cross section indicated, with riveted and soldered joints, complete with end pieces, outlet tubes, and other special accessories as required. Fabricate in minimum 96-inch- long sections. Fabricate expansion joints and accessories from same metal as gutters unless otherwise indicated.
  - 1. Fabricate from the following materials:
    - a. Stainless Steel: 0.016 inch thick.

## **2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS**

- A. Copings: Fabricate in minimum 96-inch- long, but not exceeding 10-foot- long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, seal, and solder or weld watertight.
  - 1. Fabricate from the following materials:
    - a. Aluminum: 0.050 inch thick.
- B. Roof to Wall Transition Expansion-Joint Cover: Fabricate from the following materials:
  - 1. Stainless Steel: 0.025 inch thick.
- C. Base Flashing: Fabricate from the following materials:
  - 1. Stainless Steel: 0.019 inch thick.
- D. Counterflashing: Fabricate from the following materials:

1. Stainless Steel: 0.019 inch thick.

E. Flashing Receivers: Fabricate from the following materials:

1. Stainless Steel: 0.019 inch thick.

## **2.8 MISCELLANEOUS SHEET METAL FABRICATIONS**

A. Equipment Support Flashing: Fabricate from the following materials:

1. Stainless Steel: 0.019 inch thick.

B. Overhead-Piping Safety Pans: Fabricate from the following materials:

1. Stainless Steel: 0.025 inch thick.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 UNDERLAYMENT INSTALLATION**

A. General: Install underlayment as indicated on Drawings.

B. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Apply primer if required by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

### **3.3 INSTALLATION, GENERAL**

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings,

separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
  2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
  3. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
  4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
  5. Install sealant tape where indicated.
  6. Torch cutting of sheet metal flashing and trim is not permitted.
  7. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
1. Coat back side of uncoated aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
  2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.
- C. 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 watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
- D. Fastener Sizes: Use fasteners of sizes that will penetrate metal decking not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Seal joints as shown and as required for watertight construction.
1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
  2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."
- F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches, except reduce pre-tinning where pre-tinned surface would show in completed Work.
1. Do not solder aluminum sheet.
  2. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

3. Stainless-Steel Soldering: Tin edges of uncoated sheets using solder recommended for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

- G. Rivets: Rivet joints in uncoated aluminum where indicated and where necessary for strength.

### **3.4 ROOF DRAINAGE SYSTEM INSTALLATION – N/A**

### **3.5 ROOF FLASHING INSTALLATION – N/A**

### **3.6 WALL FLASHING INSTALLATION**

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

### **3.7 MISCELLANEOUS FLASHING INSTALLATION**

- A. Overhead-Piping Safety Pans: Suspend pans independent from structure above as indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.
- B. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

### **3.8 ERECTION TOLERANCES**

- A. Installation Tolerances: Shim and align sheet metal flashing and trim 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.
- B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

### **3.9 CLEANING AND PROTECTION**

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.



- E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 62 00

## SECTION 07 92 00 - JOINT SEALANTS

### 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. Silicone joint sealants.
  - 2. Urethane joint sealants.
  - 3. Latex joint sealants.
  - 4. Preformed joint sealants.
  - 5. Acoustical joint sealants.
- B. Related Sections:
  - 1. Section 07 62 00 "Sheet Metal Flashing and Trim".

#### 1.3 PRECONSTRUCTION TESTING

- A. Compatibility and Adhesion Testing for Exterior Enclosure Sealants: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
  - 1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
  - 2. Submit not fewer than eight pieces of each kind of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
  - 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
  - 4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
  - 5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.
- B. Field-Adhesion Testing: Before installing sealants, field test the adhesion of sealants to Project-specific joint substrates as follows:
  - 1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect or HAS Project Manager.
  - 2. Conduct field tests for each application indicated below:

- a. Each kind of sealant and joint substrate indicated.
3. Notify Architect or HAS Project Manager seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
  - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
    - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
- 6.
7. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

#### **1.4 PREINSTALLATION MEETINGS**

- A. Preinstallation Meeting: Conduct conference at Project site no later than two weeks before the start of joint sealant installation. Meet with Installer, Owner, Architect, and installers of components of the exterior enclosure system. Review methods and procedures for installing work related to joint sealants including, but not limited to, the following:
  1. Review foreseeable methods and procedures related to sealing joints between substrates, including but not limited to, the following:
    - a. Review joint substrates requiring sealant and the condition of each surface, sealant application, flashing details, and other preparatory work.
    - b. Review joint sealant requirements as indicated on the drawings and in the specifications and other contract documents.
    - c. Review required submittals.
    - d. Review potential weather conditions and procedures for addressing unfavorable conditions.
  2. Record discussion and furnish copy of recorded discussions to each attendee.

#### **1.5 ACTION SUBMITTALS**

- A. Product Data: For each joint-sealant product indicated.
  1. Certification by joint sealant manufacturer that sealants, primers, and cleaners required for complete installation comply with local regulations controlling use of volatile organic compounds (VOC).
- B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For sealants, primers, and cleaners used inside the weatherproofing system, documentation including printed statement of VOC content.
- C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Joint-Sealant Schedule: Include the following information:
  1. Joint-sealant application, joint location, and designation.
  2. Joint-sealant manufacturer and product name.
  3. Joint-sealant formulation.
  4. Joint-sealant color.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.
- C. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- E. Preconstruction Testing Reports:
  1. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
    - a. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
    - b. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
  2. Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- F. Post-Construction Testing Reports:
  1. Field-Adhesion Test Reports: For each sealant application tested.
- G. Warranties: Sample of special warranties.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.
- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
  - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
  - 2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
- D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials in compliance with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

## 1.9 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
  - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
  - 2. When joint substrates are wet.
  - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
  - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.
- B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
- C. Joint-Substrate Conditions:
  - 1. Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

2. Do not proceed with installation of joint sealants if joint substrates are irregular, chipped, spalled, or otherwise unsuitable for long term adhesion.

### **1.10 WARRANTY**

- A. Special Installer's Warranty: Installer's written form in which Installer agrees to repair or replace joint sealants that fail and do not comply with performance and other requirements specified in this Section within specified warranty period. Failure includes, but is not limited to, the following:
  1. Failure to maintain airtight or watertight joints.
  2. Adhesive or cohesive failure
  3. Loss of abrasion resistance, stain resistance, weather resistance, or general durability.
  4. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's written form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
  1. Warranty Period: Twenty years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
  1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
  2. Disintegration of joint substrates from natural causes exceeding design specifications.
  3. Mechanical damage caused by individuals, tools, or other outside agents.
  4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

### **1.11 SEQUENCING AND SCHEDULING**

- A. Schedule installations of joint sealants to occur not less than 21 days nor more than 30 days after completion of waterproofing or sealing of substrates unless otherwise indicated.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS, GENERAL**

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
  2. Sealant Primers for Nonporous Substrates: 250 g/L.
  3. Sealant Primers for Porous Substrates: 775 g/L.
- C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- D. Stain-Test-Response Characteristics: Where sealants are specified to be non-staining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- E. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- F. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide elastomeric joint sealants that are water, ozone, chemical, and UV resistant and will not detrimentally affect joint substrates.
- C. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

## 2.3 SILICONE JOINT SEALANTS

- A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant (JS-01): ASTM C 920, Type S, Grade NS, Class 50, for Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; 756 SMS.
    - b. Tremco Incorporated; Spectrem 2.
- B. Mildew-Resistant, Single-Component, Silicone Joint Sealant (JS-02): ASTM C 920, Type S, Grade NS, Class 25 or 50, for Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; 786 Mildew Resistant.
    - b. Tremco Incorporated; Tremsil 200 Sanitary.

## 2.4 URETHANE JOINT SEALANTS

- A. Single-Component, Nonsag, Traffic-Grade, Urethane Joint Sealant (JS-03): ASTM C 920. Type S, Grade NS, Class 25, for Use T.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. BASF Building Systems; Sonolastic Ultra.
    - b. Sika Corporation, Construction Products Division; Sikaflex - 1a.
    - c. Tremco Incorporated; Vulkem 116.
- B. Multicomponent, Nonsag, Traffic-Grade, Urethane Joint Sealant (JS-04): ASTM C 920, Type M, Grade NS, Class 25, for Use T.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. BASF Building Systems; Sonolastic NP 2.
    - b. LymTal International, Inc.; Iso-Flex 881.
    - c. Sika Corporation, Construction Products Division; Sikaflex - 2c NS.

## 2.5 LATEX JOINT SEALANTS

- A. Latex Joint Sealant (JS-05): Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. BASF Building Systems; Sonolac.
    - b. Pecora Corporation; AC-20+.
    - c. Tremco Incorporated; Tremflex 834.

## 2.6 PREFORMED JOINT SEALANTS

- A. Preformed Foam Joint Sealant: Manufacturer's standard preformed, pre-compressed, open-cell foam sealant manufactured from urethane foam with minimum density of 10 lb/cu. ft. and impregnated with a nondrying, water-repellent agent. Factory produce in pre-compressed sizes in roll or stick form to fit joint widths indicated; coated on one side with a pressure-sensitive adhesive and covered with protective wrapping.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. EMSEAL Joint Systems, Ltd.; Emseal 25V.
    - b. Sandell Manufacturing Co., Inc.; Polyseal.

## 2.7 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Joint Sealant (JS-06): Nonsag, paintable, non-staining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.



1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Momentive Performance Materials; RCS 20.
  - b. Pecora Corporation; AC-20 FTR.
  - c. USG Corporation; SHEETROCK Brand Acoustical Sealant.

## **2.8 JOINT SEALANT BACKING**

- A. General: Provide sealant backings of material that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
  1. Type C: Closed-cell material with a surface skin.
  2. Type B: Bicellular material with a surface skin.
  3. Either of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated,
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.
- D. Weep and Vent Tubes: Clear plastic (PVC) tubing, minimum 1/4 inch inside diameter. At window systems, where required by system designer, provide gutter termination of tube with preformed nipples suitable for sealing to gutter.
- E. Cork Joint Filler: Resilient and non-extruding, ASTM D1752, Type II and AASHTO M 153, Type II.
- F. Ceramic Blanket Joint Filler: Noncombustible ceramic blanket joint filler made from alumina-silica fibers and tested to pass ASTM E119 for fire ratings shown; flame spread of 0 per ASTM E84; melting point 1760 degrees C.; service temperature 1260 degrees C.; and meeting MIL 1-23128A Grade A or B; one of the following:
  1. Manville Products Co.; Cerablanket-FS.
  2. Morgan Thermal Ceramics; Kaowool FireMaster Blanket.
  3. Williams Products, Inc.; Williams DynaShield Ceramic Fiber.

## **2.9 MISCELLANEOUS MATERIALS**

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. 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.

- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- 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.

#### **3.2 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 porous joint substrate surfaces by brushing, grinding, 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. Remove laitance and form-release agents from concrete.
  - 3. Clean nonporous joint substrate 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 by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or 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 or primer 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.

#### **3.3 INSTALLATION OF JOINT SEALANTS**

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- 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. Sealant Backings: Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of sealant backings.
  2. Do not stretch, twist, puncture, or tear sealant backings.
  3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Bond-Breaker Tape: Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Sealant Installation: Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
  2. Completely fill recesses in each joint configuration.
  3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
  4. Apply sealants in the depth shown or, if none is shown, apply in accordance with the manufacturer's recommendations and the following general proportions and limitations:
    - a. Apply elastomeric sealants in sidewalk, pavement and similar horizontal joints to a depth equal to 75 percent of the joint width, but not less than 3/8 inch (9 mm) and not more than 3/4 inch (19 mm).
    - b. Apply elastomeric sealants, in joints not subject to traffic or other abrasion, to a depth equal to 50 percent of the joint width, but not less than 1/4 inch (6 mm) and not more than 1/2 inch (13 mm).
    - c. Apply non-elastomeric sealants to a depth approximately equal to the joint width.
  5. Pour self-leveling compounds in horizontal joints to a level approximately 1/16 inch (1.5 mm) below adjacent surfaces.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
  2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  3. Provide a slight wash on horizontal joints where horizontal and vertical surfaces meet.
  4. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
    - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.
- G. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping. Do not pull or stretch material. Produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures, apply heat to sealant in compliance with sealant manufacturer's written instructions.

- H. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.

### 3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
1. Extent of Testing: Test completed and cured sealant joints as follows:
    - a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
    - b. Perform 1 test for each 1000 feet of joint length thereafter or 1 test per each floor per elevation.
  2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
    - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
  3. Inspect tested joints and report on the following:
    - a. Whether sealants filled joint cavities and are free of voids.
    - b. Whether sealant dimensions and configurations comply with specified requirements.
    - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
  4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
  5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

### 3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

### 3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

### 3.7 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application (JS-01): Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Locations:
    - a. Construction joints in cast-in-place concrete.
    - b. Control and expansion joints in unit masonry.
    - c. Joints in dimension stone cladding.
    - d. Joints between metal panels.
    - e. Joints between different materials listed above.
    - f. Perimeter joints between materials listed above and frames of doors, windows, and louvers.
    - g. Control and expansion joints in ceilings, soffits, and other overhead surfaces.
    - h. Other joints as indicated.
  2. Silicone Joint Sealant: Single component, nonsag, neutral curing, Class 50.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application (JS-02): Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Sealant Location:
    - a. Other joints as indicated.
  2. Joint Sealant: Mildew resistant, single component, nonsag, neutral or acid curing, Silicone.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application (JS-03): Interior joints in horizontal traffic surfaces – N/A
- D. Joint-Sealant Application (JS-04): Exterior joints in horizontal surfaces.
1. Joint Locations:
    - a. Other joints as indicated.
  2. Urethane Joint Sealant: Multicomponent, nonsag, traffic grade, Class 25.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application (JS-05): Interior joints in vertical surfaces and horizontal nontraffic surfaces – N/A

- F. Joint-Sealant Application (JS-06): Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces – N/A

END OF SECTION 07 92 00

## SECTION 220593 - PLUMBING SYSTEM TESTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. General Conditions, Supplementary Conditions, applicable provisions of Division 01, General Requirements, and other provisions and requirements of the Contract Documents apply to work of Division 22.
- B. Each section included in Division 22 is incomplete without the provisions stated herein.

#### 1.2 SCOPE

- A. These tests are required to determine that all systems and equipment involved may be safely energized and function properly.
- B. Perform tests by and under the supervision of fully experienced and qualified personnel. Advise each respective manufacturer's representative of tests on their equipment.
- C. Record all test data.
- D. Each section of Division 22 that has products or systems listed herein, incorporate this section by reference and is incomplete without the required tests stated herein.

#### 1.3 REPORTS

- A. Submit the proposed test procedures and copies of proposed report forms for review a minimum of ninety (90) days prior to requesting a final review by the owner and Architect/Engineer (A/E).
- B. Furnish bound copies of test data that is neatly typed and arranged including, as a minimum, the date and time of testing, personnel present, weather conditions, nameplate record of test instrument and list all measurements taken, both prior to and after any corrections are made to the system. Record all failures and corrective action taken to remedy incorrect situation.

#### 1.4 REFERENCES

- A. AABC - 2002. National Standards for Total System Balance, 6th edition.
- B. ANSI/ASHRAE Standard 15, Safety Standard for Refrigeration Systems.
- C. AHRI 550/590-2003 – Performance Rating of Water Chilling Packages Using the Vapor Compression Cycle.
- D.
- E. ASHRAE - 2019 HVAC Applications Handbook: Chapter 39 - Testing, Adjusting and Balancing.
- F. ASHRAE - 2019 HVAC Applications Handbook: Chapter 44 - HVAC Commissioning.

- G. ASHRAE - 2019 HVAC Applications Handbook: Chapter 49, Noise and Vibration Control.
- H. ASHRAE Guideline 0 – 2019, The Commissioning Process.
- I. ASME B31.5 – Refrigeration Piping and Heat Transfer Components.

## PART 2 - PRODUCTS

Not Used.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Furnish proposed test procedures, recording forms, list of personnel and test equipment for review.
- B. Follow industry standard practices and procedures for testing, balancing, and commissioning as listed in paragraph 1.3 above.
- C.
- D. The owner must be notified a minimum of three (5) business days prior to any tests being conducted.

### 3.2 PLUMBING EQUIPMENT

- A. Plumbing System: Perform operational tests to demonstrate satisfactory operation. Provide written reports including, as a minimum, the following information:
  - 1. Time, date, and duration of test for each system.
  - 2. Water pressures at the most remote and highest fixtures.
  - 3. Operation of each fixture (Potable Water Cabinet) and fixture trim.
  - 4. Operation of each valve.
  - 5. Piping systems: Test results of all pressure tests.
- B. Sanitary Waste, Vent and Storm Drainage Systems:
  - 1. Inspect, test and clean drains at base of rotunda for condensate drain.
  - 2. Cleaning:
    - a. Clean all drains and pipes prior to testing by flushing with high pressure water and removing debris by vacuum extraction, and by removing soil sediment, concrete, or other debris.
    - b. Do not discharge soil sediment or debris to drainage channels, existing storm sewers, or existing sanitary sewers.
- C. Domestic Water System: From building connection to Potable Water Cabinet
- D.

## PART 4 -

- 1. Prior to any field activity, Contractor must inspect and verify existing domestic water lines are in satisfactory condition. If any cracking, chaffing, or visible wear



- is observed, contractor is to replace with a new line. Contractor must submit for approval a cleaning and flushing plan detailing all equipment to be used in the cleaning and flushing process and a schematic drawing showing the arrangement of pumps, strainers, piping, valves, hoses, etc. All equipment must be certified clean and free of any oils or other contamination. All chemical treatment equipment must include secondary containment
2. Hydrostatically test all cold water piping. Test in place with hydrostatic test and maintain pressure without pumping for twenty-four (24) hours. Any leaks shall be repaired, and the entire test shall be repeated.
  3. Completely flush water circulating system with water with strainers removed. Fill system with water with strainer installed and circulate water for forty-eight (48) hours minimum with a one inch (1") bleed valve open until bleed water is clear. After completing this operation, chemically treat system, clean strainer and open to central system.
  4. Thoroughly flush all new domestic water piping and tanks and then treat and sterilize with HTH or a liquid chlorine gas and water solution, or a direct chlorine gas placed in the upstream side in amounts to give a dosage of 50 ppm chlorine calculated on the volume of water the piping will contain. A minimum residual of 5 ppm chlorine shall remain in all parts of the system for a minimum of 24 hours. After sterilizing, flush all lines thoroughly. The foregoing shall be considered minimum requirements. The sterilization shall be in accordance with local utility company requirements.
  5. Under no circumstances shall the Contractor permit the use of any portion of the domestic water system until new piping has been properly sterilized and certified same by the local water department.
  6. Provide Test results of disinfection of domestic water piping system.

END OF SECTION - 220593

## SECTION 22 07 19 - PLUMBING PIPING INSULATION

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Thermal insulation for plumbing piping systems including jackets and accessories.

#### 1.2 REFERENCES

- A. City of Houston Commercial Energy Conservation Code.
- B. ASTM B209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- C. ASTM C165 – Test Method for Measuring Compressive Properties of Thermal Insulation.
- D. ASTM C168 – Terminology Relating to Thermal Insulating Materials.
- E. ASTM C195 – Specification for Mineral Fiber Thermal Insulating Cement.
- F. ASTM C335 – Test Method for Heat Transfer Properties of Horizontal Pipe Insulation.
- G. ASTM C411 – Test Method for Hot-Surface Performance of High Temperature Thermal Insulation.
- H. ASTM C461 – Test Methods for Mastics and Coatings Used With Thermal Insulation.
- I. ASTM C518 – Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- J. ASTM C533 – Specification for Calcium Silicate Block and Pipe Thermal Insulation.
- K. ASTM C534 – Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- L. ASTM C547 – Specification for Mineral Fiber Pipe Insulation.
- M. ASTM C585 – Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- N. ASTM C591 – Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
- O. ASTM C795 – Specification for Thermal Insulation for Use in Contact With Austenitic Stainless Steel.
- P. ASTM C921 – Jackets for Thermal Insulation.

- Q. ASTM C1104 – Test Method for Measuring Water Vapor Sorption of Fibrous Thermal Insulation Materials.
- R. ASTM C1126 – Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.
- S. ASTM C1136 –Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
- T. ASTM C1338 – Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
- U. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
- V. ASTM E96 – Standard Test Methods for Water Vapor Transmission of Materials.

### 1.3 SUBMITTALS

- A. Manufacturer's product data to include the following:
  - 1. Application Company Qualifications.
  - 2. Product descriptions.
  - 3. Provide a table indicating piping system, insulation type, density, and thickness for each type of piping system in the project.
  - 4. Manufacturer's installation instructions.
- B. Submit product data for:
  - 1. Pipe insulation.
  - 2. Pipe insulation jackets.
  - 3. Adhesives.
  - 4. Sealants.
  - 5. General materials.
- C. Refer to Section 01 33 29 for additional shop drawing and submittal preparation and submission requirements.

### 1.4 CLOSEOUT SUBMITTAL

- A. Submit Operation and Maintenance Manuals for the project in accordance with Section 01 78 23.12.

### 1.5 QUALITY ASSURANCE

- A. Application Company Qualifications: The installing company must be in the business of insulation installation for the previous consecutive five year period. The installing company must also be regularly engaged in installing the specific specified insulation material types on projects of equal or greater magnitude and scope as this project for the previous consecutive five-year period.

- B. Application Personnel Qualifications: The installing company must provide qualified installation personnel on this project jobsite directly employed by them who are skilled and proficient at installing the specific specified insulation material types.
- C. All materials (to include, but not limited to, insulation, jackets, facings, coatings, mastics, adhesives, sealants, etc.) installed inside the building must have a certified and tested composite flame spread/smoke developed rating of 25/50 in accordance with ASTM E84.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Armacell (Type P4)
- B. Certainteed Corporation (Type P2).
- C. ITW (Type P5).
- D. Johns Manville Corporation (Type P2 / Type P3).
- E. K-Flex (Type P2)
- F. Knauf (Type P2).
- G. Kingspan Corporation (Type P1 / Type P5).
- H. Owens-Corning (Type P2).
- I. Pittsburgh Corning (Type P6).
- J. Resolco (Type P1).

### 2.2 PIPING INSULATION MATERIALS

- A. Type P1: Rigid Phenolic Kingspan Corporation, Koolphen K", " , Resolco Insul-Phen").
  - 1. Specification Compliance: ASTM C1126, Type 3, ASTM C795.
  - 2. 'K' Value: 0.13 Btu x inch/(hour x ft<sup>2</sup> x °F) at 75 °F (ASTM C518).
  - 3. Maximum Service Temperature: 225 degrees-F.
  - 4. Factory Vapor Retarder Jacket: ASJ (All-Service Jacket) facing (ASTM C1136 – Type 1).
- B. Type P2: Mineral Fiber ("Fiberglass").
  - 1. Specification Compliance: ASTM C547, Type 1.
  - 2. 'K' Value: 0.23 Btu x inch/(hour x ft<sup>2</sup> x °F) at 75 °F (ASTM C335).
  - 3. Maximum Service Temperature: 800 degrees-F.
  - 4. Factory Vapor Retarder Jacket: ASJ (All-Service Jacket) facing (ASTM C1136 – Type 1).
- C. Type P3: Hydrous Calcium Silicate.

1. Specification Compliance: ASTM C533, Type 1
2. 'K' Value: 0.41 BTU x in./(hr. x ft<sup>2</sup> x °F) at 200 °F (ASTM C518).
3. Maximum Service Temperature: 1200 degrees-F.
4. Factory Vapor Retarder Jacket: None.

D. Type P4: Flexible Elastomeric (Armacell "Armaflex®", K-Flex USA "K-Flex® LS")

1. Specification Compliance: ASTM C534, Type 1
2. 'K' Value: 0.27 BTU x in./(hr. x ft<sup>2</sup> x °F) at 75 °F (ASTM C518).
3. Maximum Service Temperature: 220 Degrees-F.
4. Factory Vapor Retarder Jacket: None.

E. Type P5: Polyisocyanurate (ITW "Trymer", Kingspan "Nilflam").

1. Specification Compliance: ASTM C591, Type 1
2. 'K' Value: 0.16 BTU x in./(hr. x ft<sup>2</sup> x °F) at 75 °F (ASTM C177).
3. Maximum Service Temperature: 300 Degrees-F
4. Factory Vapor Retarder Jacket: ASJ (All-Service Jacket) facing (ASTM C1136 – Type 1).
5. Note: Does not meet Smoke Developed requirement of less than 50 when tested in accordance with ASTM E84. Use for outdoor systems only.

F. Type P6: Cellular Glass (Pittsburg Corning "Foamglas").

1. Specification Compliance: ASTM C552.
2. 'K' Value: 0.29 BTU x in./(hr. x ft<sup>2</sup> x °F) at 75 °F (ASTM C177).
3. Maximum Service Temperature: 900 Degrees-F.
4. Factory Vapor Retarder Jacket: ASJ (All-Service Jacket) facing (ASTM C1136 – Type 1).
5. Water Vapor Permeability: 0.00 perm-in. (ASTM E96).

### 2.3 INSULATION ACCESSORIES

A. Pipe Support Inserts:

1. Block Insert: Type P1, Rigid Phenolic inserts with a density of 5.0 lbs/cu. ft.
2. Support Shield: Minimum 16-gauge galvanized steel metal support shield with an inside diameter equal to the outside diameter of the pipe and insulation that covers the bottom 180 degrees of the bottom of the piping and insulation. .

B. Jackets:

1. Factory vapor retarder jacket as specified above.
2. PVC Jackets: One piece, premolded type, to meet flame spread and smoke developed rating of 25/50 in accordance with ASTM E 84. Sealed with PVC cement.
3. Canvas Jackets: UL listed treated cotton fabric, 6 ounces per square yard.
4. Stainless Steel Jackets: Aluminum; 0.020 inch thick; smooth finish.
5. Metal Jacket Bands: Three-eighths inch (3/8") wide; 0.010 inch thick stainless steel to match jacket.

- C. Adhesives:
  - 1. Adhesives shall conform to ASTM C916 and ASTM E84.
  - 2. Lagging Adhesive: Suitable for bonding fibrous glass cloth to faced and unfaced insulation, or for bonding fibrous glass insulation to metal surfaces equal to Foster 30-36. Provide products suitable for type of insulation being used.
  - 3. Contact Adhesive: Neoprene based, rubber based, or elastomeric type. Adhesive shall not adversely affect, at any time, the insulation to which it is applied. Adhesive shall not emit any odors, or toxic chemicals after drying. Solvent dispersing mediums shall not contain benzene or carbon tetrachloride.
  - 4. Provide products suitable for type of insulation being used.
  
- D. Vapor Retarder Mastic Coating:
  - 1. Water-based, flexible, high solids vapor barrier finish equal to Foster 30-33.
  - 2. Appropriately selected for indoor or outdoor application.
  - 3. Color: White.
  - 4. Vapor Permeance: 0.07 perms at 43 mils dry, as determined according to procedure B of ASTM E96.
  - 5. Suitable for service temperature of pipe.
  
- E. Joint Sealant/Vapor Stop:
  - 1. Butyl polymer type, styrene-butadiene rubber type or butyl type equal to Foster 95-30.
  - 2. Maximum vapor transmission of 0.02 perms.
  - 3. Combustibility: Negligible.
  
- F. Cements:
  - 1. Mineral fiber insulation cement shall conform to ASTM C195.
  - 2. Finishing Cement: ASTM C449 mineral fiber hydraulic setting thermal insulating and finishing cement.
  
- G. Fibrous Reinforcing Glass Cloth and Glass Tape:
  - 1. Mesh Size: 20x20.
  - 2. Tape Size: Four inch (4") wide roll.
  - 3. Class 3 tape shall be 4.5 ounces per square yard.
  
- H. Caulking: ASTM C920, Type S, Grade NS, Class 25, Use A.
  
- I. Insulation Bands: 3/4 inch wide, 26 gauge stainless steel.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Thoroughly clean all surfaces to be insulated as required to remove all oil, grease, loose scale, rust, and foreign matter.
  
- B. Piping must be completely dry at the time of application. The installation of piping insulation associated with an operating chilled water system is strictly prohibited.

- C. PROVIDE PRIMER COAT ON ALL PIPING, TO INCLUDE FIELD WELDS AND OVER FACTORY APPLIED PAINT/COATING. Refer to Mechanical identification Section of the Specifications. Primer paint shall be approved by the insulation manufacturer for installation contact with their insulation type. Painting must be completed and approved by the Engineer prior to installation of insulation.
- D. Install insulation material only after all performance tests on piping have been completed and approved by the Engineer.

### 3.2 INSTALLATION

- A. Any materials found, by the Architect/Engineer (A/E), to be improperly installed or not installed in total compliance with the specific installation instructions and methods (written or implied) of the material manufacture, must be removed by the installing company. The preparation instructions must be followed prior to the re-installation of the insulation material using the correct installation instructions and methods of the material manufacturer.
- B. The insulation shall be installed after the pipe testing has been successfully completed and heat tracing has been installed, tested and found to be working properly, if piping is indicated to be heat traced.
- C. Install materials in complete and total compliance with the specific manufacturer's installation instructions and the following instructions.
- D. Wherever possible, the insulation shall have a factory applied flexible, ASJ vapor retarder as specified above. Where it is necessary to field apply the vapor retarder, insulation without an ASJ jacket shall be secured with a fiber-reinforced strapping tape, and apply a vapor retarder mastic and fabric system.
- E. Apply three inch (3") wide matching butt strips to all circumferential joints with a fifty-percent (50%) overlap. For pipes greater than twelve inch (12") diameter, apply strips on twelve inch (12") centers.
- F. Continue vapor barrier through wall and floor penetrations.
- G. In exposed piping, locate insulation and cover seams in least visible locations.
- H. Insulate fittings, valves, flanges and strainers to the same thickness as the pipe. Allow space for flange and valve bolt removal without disturbing the pipe insulation. Provide vapor retarder mastic end caps on valve/fitting and pipe interface where insulation "steps up" to a different level.
- I. Fittings, valves, and strainers shall be insulated with two (2) piece (split along the length of fitting) factory fabricated preformed insulation matching pipe insulation. Where formed pieces are unavailable or impractical, fabricate with mitered segments (minimum four (4) equal segments) in accordance with ASTM C450 utilizing insulation equal to the insulation applied to the adjoining pipe. Insulation "diapers" are not acceptable (NO EXCEPTIONS).

- J. On flexible connections, expansion joints and unions, bevel and seal ends of insulation and continue sealant a minimum of four inches (4") along the piping.
- K. On insulated domestic water piping conveying fluids between 100 degrees F and 140 degrees F, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation at such locations. Apply a continuous seal a minimum of four inches (4") along the piping.
- L. Provide an insert of same thickness and contour as adjoining insulation, between support shield and piping, and under the finish jacket, to prevent insulation from sagging at support points. Provide inserts and shields as detailed on the Drawings. Insulating insert material shall be high-density phenolic foam as described hereinbefore with a minimum 5.0 lbs/cubic feet that is a minimum of six inches (6") longer than the metal pipe shield. It shall be suitable for the planned temperature range. Factory fabricated inserts with integral galvanized pipe saddles are recommended. Adhere pipe support shield to insulation with adhesive.
- M. Neatly finish and seal all insulation at supports, protrusions and interruptions. Insulation shall extend a minimum of three (3) times the insulation thickness along the protrusion. Maintain vapor barrier with finish coat.
- N. All terminations shall be sealed with a vapor retarder mastic and fabric system. Mastic shall extend onto the pipe and vapor retarder.
- O. Insulate tubing from trap primers and trap primer manifolds to floor drains per the insulation specified domestic cold water.
- P. All gauge cocks, temperature/pressure taps, thermometer wells, etc. shall be fully insulated with closed cell flexible insulation with all joints sealed vapor tight. Insulation shall be applied to tightly to device piping with no gaps.
- Q. On all cold water piping (lower than ambient) where piping is interrupted by fittings, flanges, valves, or hangers, and at intervals not exceeding twenty-one feet (21') on continuous runs, an insulation isolation seal shall be formed between the vapor barrier jacket and the bare pipe by liberal applications of Foster 30-33 or Childers CP 33 flexible vapor barrier joint sealant to the ends of the pipe insulation. This seal requirement is in addition to regular joint vapor seal specified hereinbefore. The seal location shall be identified by an orange color three-quarters inch ( $\frac{3}{4}$ " ) wide press-tite tape around the circumference of the insulation on field insulated piping. The Engineer shall select at least four (4) locations in the insulation that the completed seal procedure will be reviewed. Inspected seal area shall be resealed after review.
- R. All piping exposed to outside shall have metal jackets as described hereinbefore applied over the insulation with the joints on the bottom of the piping.
- S. If grooved piping is utilized, the insulation contractor shall provide factory, pre-molded insulation fittings specifically constructed to tightly fit over coupling, fittings, etc. Insulation diapers or other methods of insulating the fittings are not acceptable.



3.3 Apply insulation according to the insulation application and thickness schedule below.

<b>Pipe Insulation Material Application and Thickness Schedule</b>				
<b>Piping Application</b>	<b>Insulation Type**</b>	<b>Insulation Density (lbs. per cu. ft.)</b>	<b>Nominal Pipe Size (in.)</b>	<b>Insulation Thickness (in.)</b>
<b>Indoor – Concealed Jacket: Factory ASJ</b>				
Cold Condensate	P1	2.2	All Sizes	3/4
Domestic Cold Water	P2	3.0	1-1/2 and Smaller	1
			2 through 4	1-1/2
			6 and Larger	2
Domestic Hot Water	P2	3.0	1-1/2 and Smaller	1
			2 through 4	1-1/2
			6 and Larger	2
Roof/Overflow Drains and Cold Condensate Drains*	P2	3.0	2 through 4	1
			6 and Larger	1
<b>Indoor – Exposed</b>				
<b>1- Finished Space: Factory ASJ – Painted according to Architect’s Instructions</b> <b>2- Exposed in Mechanical Room or Unfinished Space:</b> a) 6’-0” AFF or higher: Factory ASJ b) Below 6’-0” AFF: Factory ASJ with Canvas and Finishing Cement, or PVC, or Metal Outer Jacket <b>3- Central Plant/Machinery Room</b> a) 6’-0” AFF or higher: Factory ASJ b) Below 6’-0” AFF: Factory ASJ with Canvas and Finishing Cement, or Metal Outer Jacket				
Cold Condensate	P1	2.2	All Sizes	3/4
Domestic Cold Water	P1	2.2	1-1/2 and Smaller	3/4
			2 through 4	1
			6 and Larger	1-1/2
Domestic Hot Water	P1	2.2	1-1/2 and Smaller	3/4
			2 through 4	1
			6 and Larger	1-1/2
Roof/Overflow Drains and Cold Condensate Drains*	P1	2.2	2 through 4	1
			6 and Larger	1

<b>Pipe Insulation Material Application and Thickness Schedule</b>				
<b>Piping Application</b>	<b>Insulation Type**</b>	<b>Insulation Density (lbs. per cu. ft.)</b>	<b>Nominal Pipe Size (in.)</b>	<b>Insulation Thickness (in.)</b>
<b>Outdoor and Unconditioned Indoor Jacket: Factory ASJ Jacket with Metal Outer Jacket.</b>				
Domestic Cold Water	P1	2.2	4 and Smaller	3/4
			6 and Larger	1
Domestic Hot Water	P1	2.2	4 and Smaller	3/4
			6 and Larger	1

\* Includes underside of all roof/overflow drain bodies and related horizontal roof drain lines up to and three feet (3') past the first turn down elbow, and all floor drain bodies and related horizontal sanitary drain lines over to the vertical riser above occupied areas which receive cold condensate drainage or refrigerated drinking fountain drainage. Provide insulation isolation seals as specified for piping handling below ambient fluids.

\*\* Where multiple insulation types are listed for a service, any of those listed may be used for that service. Where multiple thicknesses are listed – they correspond to the position of the insulation type before and after the "/" symbol.

END OF SECTION

## SECTION 22 11 16 - DOMESTIC WATER PIPING

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Domestic water piping, including valves and fittings.
- B. Miscellaneous apparatus attached to plumbing piping systems.

#### 1.2 REFERENCES

- A. ASME A112.26.1M - Water Hammer Arresters.
- B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- C. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- D. ASSE 1011 - Hose Connection Vacuum Breakers.
- E. ASSE 1013 - Backflow Preventers, Reduced Pressure Principle.
- F. ASSE 1019 - Wall Hydrants, Frost-Proof Automatic Draining Anti-Backflow Types.
- G. ASTM A 47 - Ferritic Malleable Iron Castings.
- H. ASTM A 53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- I. ASTM A 234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- J. ASTM B 32 - Solder Metal.
- K. ASTM B 88 - Seamless Copper Water Tube.
- L. ASTM B 306 - Copper Drainage Tube (DWV).
- M. AWS A5.8 - Brazing Filler Metal.
- N. AWWA C111 - Rubber Gasket Joints for Ductile Iron and Gray-Iron Pressure Pipe and Fittings.
- O. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
- P. AWWA C606 - Grooved and Shouldered Joints.
- Q. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.
- R. PDI WH-201 - Water Hammer Arresters.

### 1.3 SUBMITTALS

- A. Include data on pipe materials, pipe fittings, and special fabricated items.
- B. Include component sizes, rough-in requirements, service sizes and finishes for specialties.
- C. Refer to Section 01 33 29 for additional shop drawing and submittal preparation and submission requirements.

### 1.4 CLOSEOUT SUBMITTALS

- A. Submit Operation and Maintenance (O&M) Manuals for the project in accordance with Section 01 78 23.12.

### 1.5 QUALITY ASSURANCE

- A. For each product specified, provide components by same manufacturer throughout project.

## PART 2 - PRODUCTS

### 2.1 WATER PIPING

- A. Below Grade Beyond Five Feet (5') of Building:
  - 1. Cast Iron Piping: AWWA C151.
    - a. Fittings: Ductile or gray iron, standard thickness.
    - b. Joints: AWWA C111, rubber gasket with 3/4-inch diameter rods.
  - 2. Copper Tubing: ASTM B 88, Type K, hard drawn.
    - a. Fittings: ASME B16.18 cast bronze or ASME B16.22 wrought copper or bronze.
    - b. Joints: AWS A5.8 BCuP silver braze (lead free).
- B. Below Grade Within Five Feet (5') of Building:
  - 1. Pipe Two Inches (2") and Smaller; Copper Tubing: ASTM B 88, Type K, annealed.
    - a. Fittings: None.
    - b. Joints: AWS A5.8 BCuP silver braze (lead free).
  - 2. Pipe Over Two Inches (2"); Copper Tubing: ASTM B 88, Type K, hard drawn.
    - a. Fittings: ASME B16.18, cast bronze or ASME B16.22, wrought copper and bronze.
    - b. Joints: AWS A5.8 BCuP silver braze (lead free).

- C. Above Grade:
  - 1. Pipe Two and one-half Inches (2-1/2") and Smaller; Copper Tubing: ASTM B 88, Type L, hard drawn.
    - a. Fittings: ASME B16.18, cast bronze, or ASME B16.22 wrought copper and bronze.
    - b. Joints: ASTM B 32, solder, Grade 95TA (lead free).
  - 2. Pipe Over Two and one-half Inches (2-1/2"):
    - a. Galvanized Steel Pipe: ASTM A 53, Schedule 40.
      - 1) Fittings: Cast iron.
      - 2) Joints: Grooved mechanical couplings.
    - b. Copper Tubing: ASTM B 88, Type K, hard drawn.
      - 1) Fittings: ASME B16.18, cast bronze or ASME B16.22, wrought copper and bronze.
      - 2) Joints: AWS A5.8 BCuP silver braze (lead free).

## 2.2 UNIONS, FLANGES AND COUPLINGS

- A. Pipe Two Inches (2") and Smaller:
  - 1. Ferrous Piping: 150 pounds per square inch-gage malleable iron threaded unions.
  - 2. Copper Tubing: 150 pounds per square inch-gage bronze unions with soldered joints.
- B. Pipe Over Two Inches (2"):
  - 1. Ferrous Piping: 150 pounds per square inch-gage forged steel weld neck flanges; 1/16-inch thick preformed neoprene gaskets.
  - 2. Copper Tubing: 150 pounds per square inch gage weld neck bronze flanges; 1/16-inch thick preformed neoprene gaskets.
- C. Grooved and Shouldered Pipe End Couplings:
  - 1. Housing: ASTM A 47, malleable iron clamps to engage and lock, designed to permit some angular deflection, contraction and expansion; steel bolts, nuts and washers; galvanized for galvanized pipe.
  - 2. Sealing gasket: "C" shape composition sealing gasket.
- D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

## 2.3 STRAINERS

- A. Y-Pattern Strainers:
  - 1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
  - 2. Body:
    - a. Bronze body with threaded connections for piping two inch (2") and smaller.
    - b. Cast iron body with flanged connections and interior lining complying with AWWA C550 or a FDA-approved epoxy coating for piping two and one-half inch (2-1/2") and larger.
  - 3. Screen: Stainless steel with round perforations, unless otherwise indicated, with perforation sizes as follows:
    - a. Piping two inch (2") and smaller: 0.033 inch.
    - b. Piping two and one-half inch (2-1/2") up to four inch (4"): 0.045 inch.
    - c. Piping six inch (6") and larger: 0.10 inch.

4. Drain: Factory-installed, hose-end drain valve with cap.

## 2.4 ESCUTCHEONS

- A. Provide escutcheons at finished surfaces where bare or insulated piping exposed to view passes through floors, walls or ceilings, except in boiler, utility or equipment rooms. Fasten securely to pipe or pipe covering.
- B. Refer to Section 22 05 18 for additional requirements.

## 2.5 PIPE DRAINS

- A. Provide three-quarter inch (3/4") drain connection in the low points of the piping with a gate valve or full port ball valve ahead of hose end adapter and cap. Disconnection of supply piping at fixture will be acceptable.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Coordinate forming of floor construction to receive drains to required invert elevations.

### 3.2 INSTALLATION

- A. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- B. Route piping in orderly manner and maintain gradient.
- C. Install piping to conserve building space and not interfere with use of space.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Provide clearance for installation of insulation and access to valves.
- G. Provide access where valves and fittings are not exposed.
- H. Establish elevations of buried piping outside the building to be below "frost line," but not less than eighteen inches (18").
- I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

- J. Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting.
- K. Excavate and backfill in accordance with the mechanical general provisions.
- L. Install hub and plain end pipe with hub end upstream.
- M. Refer to Section 22 05 23 for valve installation requirements.
- N. Use grooved mechanical couplings and fasteners only in accessible locations.
- O. Install unions downstream of valves and at equipment or apparatus connections.
- P. Install brass male adapters each side of valves in copper pipe system. Sweat solder adapters to pipe.
- Q. Slope water piping and arrange to drain at all low points.
- R. Install piping parallel with or at right angles to walls unless otherwise shown on drawings.
- S. Conceal piping above ceiling, in walls or chases, etc., unless otherwise noted on the drawings.
- T. Bending of rigid piping is not permitted, only ells shall be utilized for a change in direction.
- U. Temporarily plug or cap open ends of pipe at the end of each work day.
- V. Install specialties in accordance with manufacturer's instructions to permit intended performance.
- W. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- X. Encase exterior cleanouts in concrete flush with grade.
- Y. Install water hammer arresters complete with accessible isolation valve.
- Z. Install water hammer arresters on hot and cold water lines at the end of each battery of plumbing fixtures and at each plumbing fixture which is located remote from a battery of fixtures, unless noted otherwise on Drawings.
- AA. Provide trap primers in cold water lines for traps as shown on Drawings. Tap trap primers off the top of the domestic water supply line.

### 3.3 SERVICE CONNECTIONS

- A. Provide new water service complete with backflow preventer, water meter with by-pass valves and pressure reducing valve, as indicated.

3.4 PIPE TESTING AND CLEANING

- A. Refer to Section 22 05 93 for pipe cleaning and testing requirements.

END OF SECTION



## SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

### 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 domestic water piping specialties:
  - 1. Vacuum breakers.
  - 2. Backflow preventers.
  - 3. Water pressure-reducing valves.
  - 4. Balancing valves.
  - 5. Temperature-actuated water mixing valves.
  - 6. Hose stations.
  - 7. Hose bibbs.
  - 8. Wall hydrants.
  - 9. Ground hydrants.
  - 10. Post hydrants.
  - 11. Drain valves.
  - 12. Water hammer arresters.
  - 13. Air vents.
  - 14. Trap-seal primer valves.
  - 15. Trap-seal primer systems.
- B. Related Sections include the following:
  - 1. Division 22 Section "Domestic Water Piping" for water meters.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.

## 1.5 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.
- C. Submit Operation and Maintenance (O&M) Manuals for the project.

## 1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. NSF Compliance:
  - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
  - 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."
- C. All valves and components in contact with domestic water shall be "Lead Free" construction as defined by state and local codes as well as the Federal "Safe Drinking Water Act".

## PART 2 - PRODUCTS

### 2.1 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Ames Co.
    - b. Cash Acme.
    - c. Conbraco Industries, Inc.
    - d. FEBCO; SPX Valves & Controls.
    - e. Watts Industries, Inc.; Water Products Div.
    - f. Zurn Plumbing Products Group; Wilkins Div.
  - 2. Standard: ASSE 1001.
  - 3. Size: Piping one-quarter inch (1/4") to three inch (3"), as required to match connected piping.
  - 4. Body: Bronze.
  - 5. Inlet and Outlet Connections: Threaded.
  - 6. Finish: Rough bronze.
- B. Hose-Connection Vacuum Breakers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Arrowhead Brass Products, Inc.
  - b. Cash Acme.
  - c. Conbraco Industries, Inc.
  - d. Legend Valve.
  - e. MIFAB, Inc.
  - f. Prier Products, Inc.
  - g. Watts Industries, Inc.; Water Products Div.
  - h. Woodford Manufacturing Company.
  - i. Zurn Plumbing Products Group; Light Commercial Operation.
  - j. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1011.
  3. Body: Bronze, nonremovable, with manual drain.
  4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
  5. Finish: Rough bronze.

C. Pressure Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ames Co.
  - b. Conbraco Industries, Inc.
  - c. FEBCO; SPX Valves & Controls.
  - d. Flomatic Corporation.
  - e. Watts Industries, Inc.; Water Products Div.
  - f. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: Maximum of five (5) psig through middle 1/3 of flow range.
5. Accessories:
  - a. Valves: Ball type, on inlet and outlet.

## 2.2 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
  - a. Ames Co.
  - b. Conbraco Industries, Inc.
  - c. FEBCO; SPX Valves & Controls.
  - d. Flomatic Corporation.
  - e. Watts Industries, Inc.; Water Products Div.
  - f. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1013, USC FCCC HR, and CSA B64.5.
3. Operation: Continuous-pressure applications.
4. Maximum pressure drop shall not exceed fifteen (15) psig across the entire flow range of the assembly.
5. Configuration: Designed for horizontal, straight through configuration flow.
6. Maximum working pressure of the backflow preventer assembly is 175 psig at a continuous operating temperature of 140 °F.
7. For piping three-quarters inch (3/4") to two inch (2"):

- a. Bronze body, modular "Lead Free" design with threaded connections; two (2) independent soft seated check valves with captured springs and replaceable seats; intermediate relief valve; ball valve test cocks; quarter turn (QT) full port resilient seated bronze ball isolation valves (inlet and outlet); bronze strainer with stainless steel screen; and air gap fitting.
  - b. Watts Series LF909 or Engineer approved equal.
  8. For piping two and one-half inch (2-1/2") to ten inch (10"):
    - a. Iron body "Lead Free" design with flanged connections; two (2) independent epoxy coated and lined, FDA approved cast iron body check valves with captured springs and removable bronze seats; intermediate relief valve (cast copper body for sizes less than four inch (4") and epoxy coated and lined body for sizes four inch (4") and larger) and external sensing line; stainless steel internal parts; fused epoxy coated, FDA approved, cast iron body strainer with stainless steel screen; fused epoxy coated, FDA approved non-rising stem gate isolation valves (inlet and outlet); quarter turn (QT), full port bronze body ball valve test cocks; and air gap fitting.
    - b. Watts Series LF909 or Engineer approved equal.
  9. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
- B. Double Check Backflow Prevention Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
    - a. Ames Co.
    - b. Conbraco Industries, Inc.
    - c. FEBCO; SPX Valves & Controls.
    - d. Flomatic Corporation.
    - e. Watts Industries, Inc.; Water Products Div.
    - f. Zurn Plumbing Products Group; Wilkins Div.
  2. Standard: ASSE 1015.
  3. Operation: Continuous-pressure applications, unless otherwise indicated.
  4. Maximum pressure drop shall not exceed ten (10) psig across the entire flow range of the assembly.
  5. Maximum working pressure of the backflow preventer assembly is 175 psig at a continuous operating temperature of 110 °F.
  6. For piping three-quarters inch (3/4") to two inch (2"):
    - a. Bronze body, double check valve assembly with threaded connections; two (2) positive seating check modules with capture springs and replaceable seats; ball valve test cocks; quarter turn (QT) full port resilient seated bronze ball isolation valves (inlet and outlet), and bronze strainer with stainless steel screen.
    - b. Watts Series 007 or Engineer approved equal.
  7. For piping two and one-half inch (2-1/2") to ten inch (10"):
    - a. Iron body "Lead Free" design with flanged connections; two (2) independent epoxy coated and lined, FDA approved cast iron body check valves with captured springs and removable bronze seats; stainless steel internal parts; fused epoxy coated, FDA approved, cast iron body strainer with stainless steel screen; and fused epoxy coated, FDA approved non-

rising stem gate isolation valves (inlet and outlet); and quarter turn (QT), full port bronze body ball valve test cocks.

- b. Watts Series 709 or Engineer approved equal.

C. Backflow-Preventer Test Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Conbraco Industries, Inc.
  - b. FEBCO; SPX Valves & Controls.
  - c. Flomatic Corporation.
  - d. Watts Industries, Inc.; Water Products Div.
  - e. Zurn Plumbing Products Group; Wilkins Div.
2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

## 2.3 WATER PRESSURE REDUCING VALVES

A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Cash Acme.
  - b. Conbraco Industries, Inc.
  - c. Honeywell Water Controls.
  - d. Watts Industries, Inc.; Water Products Div.
  - e. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Body: Bronze for NPS 2 and smaller and cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
5. Valves for Booster Heater Water Supply shall include integral bypass.
6. End Connections: Threaded for NPS 2 and smaller and flanged for NPS 2-1/2 and NPS 3.

B. Water Control Valves:

1. Manufacturers: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
  - a. CLA-VAL Automatic Control Valves.
  - b. Flomatic Corporation.
  - c. OCV Control Valves.
  - d. Watts Industries, Inc.; Ames Fluid Control Systems.
  - e. Watts Industries, Inc.; Watts ACV.
  - f. Zurn Plumbing Products Group; Wilkins Div.
2. Description: Pilot-operation, diaphragm-type, single-seated main water control valve.
3. Pressure Rating: Initial working pressure as indicated on the Drawings with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
4. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
  - a. Pattern: Globe-valve design.
  - b. Trim: Stainless steel.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

2.4 BALANCING VALVES (Refer to Section 22 05 23 for valve specifications)

2.5 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Available Manufacturers: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
  - a. Armstrong International, Inc.
  - b. Cash Acme.
  - c. Conbraco Industries, Inc.
  - d. Honeywell Water Controls.
  - e. Legend Valve.
  - f. Leonard Valve Company.
  - g. Powers; a Watts Industries Co.
  - h. Symmons Industries, Inc.
  - i. Taco, Inc.
  - j. Watts Industries, Inc.; Water Products Div.
  - k. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: Refer to Drawings.

9. Valve Finish: Chrome plated.

B. Primary, Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
  - a. Armstrong International, Inc.
  - b. Lawler Manufacturing Company, Inc.
  - c. Leonard Valve Company.
  - d. Powers; a Watts Industries Co.
  - e. Symmons Industries, Inc.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Exposed-mounting, thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded or union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
9. Tempered-Water Setting: 80 deg F.
10. Valve Finish: Polished, chrome plated.
11. Piping Finish: Copper.
12. Cabinet: Factory-fabricated, stainless steel, for surface or recessed mounting and with hinged, stainless-steel door.

C. Manifold, Thermostatic, Water-Mixing-Valve Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following
  - a. Leonard Valve Company.
  - b. Powers; a Watts Industries Co.
  - c. Symmons Industries, Inc.
2. Description: Factory-fabricated, exposed-mounting, thermostatically controlled, water-mixing-valve assembly in two valve parallel arrangement.
3. Large-Flow Parallel: Thermostatic water mixing valve and downstream pressure regulator with pressure gages on inlet and outlet.
4. Small-Flow Parallel: Thermostatic water mixing valve.
5. Thermostatic Mixing Valves: Comply with ASSE 1017. Include check stops on hot- and cold-water inlets and shutoff valve on outlet.
6. Water Regulator(s): Comply with ASSE 1003. Include pressure gage on inlet and outlet.
7. Component Pressure Ratings: 125 psig minimum, unless otherwise indicated.
8. Tempered-Water Setting: 80 deg F.
9. Thermostatic Mixing Valve and Water Regulator Finish: Polished, chrome plated.
10. Piping Finish: Copper.

## 2.6 HOSE STATIONS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ARCHON Industries, Inc.

2. Armstrong International, Inc.
  3. Chicago Faucets.
  4. DynaFluid Ltd.
  5. Leonard Valve Company.
  6. Strahman Valves, Inc.
  7. T & S Brass and Bronze Works, Inc.
- B. Single-Temperature-Water Hose Stations:
1. Standard: ASME A112.18.1.
  2. Cabinet: Stainless-steel enclosure with exposed valve handle, hose connection, and hose rack. Include thermometer in front.
  3. Hose-Rack Material: Stainless steel.
  4. Body Material: Bronze with stainless-steel wetted parts.
  5. Body Finish: Rough bronze.
  6. Mounting: Wall, with reinforcement.
  7. Supply Fitting: Refer to plans for sizes, ball valve and check valve. Omit check valve if check stop is included with fitting.
  8. Hose: Manufacturer's standard, for service fluid, temperature, and pressure; 3/8 in. diameter; 35 feet long.
  9. Nozzle: With hand squeeze on-off control.
  10. Vacuum Breaker: Integral or factory-installed, non-removable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052; and garden-hose thread complying with ASME B1.20.7 on outlet.
  11. Serrated hose connections shall be brass or bronze, a minimum of 3-in long. Secure hose with double stainless steel bands at each connection.
  12. Pipe hanger shall be copper plated malleable iron split ring type with malleable iron wall plate to receive 3/8-in diameter threaded rod.
  13. Wall anchors for hose rack shall be 5/16-in threaded stainless steel anchors with 5/16-in stainless steel hex bolts.
- C. Hot and Cold Temperature-Water Hose Stations:
1. Standard: ASME A112.18.1.
  2. Cabinet: Stainless-steel enclosure with exposed valve handle, hose connection, and hose rack. Include thermometer in front.
  3. Hose-Rack Material: Stainless steel.
  4. Body Material: Bronze with stainless-steel wetted parts.
  5. Body Finish: Rough bronze.
  6. Mounting: Wall, with reinforcement.
  7. Supply Fitting: Shall be a 3/4 in combination hot and cold with ball valve and check valve. Omit check valve if check stop is included with fitting.
  8. Hose: Manufacturer's standard, for service fluid, temperature, and pressure; 3/4-in; 100 feet long.
  9. Nozzle: With hand squeeze on-off control.
  10. Vacuum Breaker: Integral or factory-installed, nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052; and garden-hose thread complying with ASME B1.20.7 on outlet.
  11. Serrated hose connections shall be brass or bronze, a minimum of 3-in long. Secure hose with double stainless steel bands at each connection.



12. Pipe hanger shall be copper plated malleable iron split ring type with malleable iron wall plate to receive 3/8-in diameter threaded rod.
13. Wall anchors for hose rack shall be 5/16-in threaded stainless steel anchors with 5/16-in stainless steel hex bolts.

## 2.7 HOSE BIBBS /HYDRANTS

### A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral or field-installation, non-removable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Rough bronze.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

### B. Non-freeze Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company.
  - b. MIFAB, Inc.
  - c. Prier Products, Inc.
  - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - e. Tyler Pipe; Wade Div.
  - f. Watts Drainage Products Inc.
  - g. Woodford Manufacturing Company.
  - h. Zurn Plumbing Products Group; Light Commercial Operation.
  - i. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounting with cover.
9. Box and Cover Finish: Polished nickel bronze.
10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Polished nickel bronze.

12. Operation for Public Areas: Operating Keys, One with each wall hydrant with locking cover.
13. Operation for Service, Non-Public Areas: Handle operation, keyless cover.

C. Non-freeze, Draining-Type Post Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. MIFAB, Inc.
  - b. Prier Products, Inc.
  - c. Simmons Manufacturing Co.
  - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - e. Tyler Pipe; Wade Div.
  - f. Watts Drainage Products Inc.
  - g. Woodford Manufacturing Company.
  - h. Zurn Plumbing Products Group; Light Commercial Operation.
  - i. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.21.3M.
3. Type: Nonfreeze, exposed-outlet post hydrant.
4. Operation: Loose key.
5. Casing and Operating Rod: Of at least length required for burial of valve below frost line.
6. Casing: Bronze with casing guard.
7. Inlet: NPS 3/4.
8. Outlet: Garden-hose thread complying with ASME B1.20.7.
9. Drain: Designed with hole to drain into ground when shut off.
10. Vacuum Breaker: Nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011; and garden-hose thread complying with ASME B1.20.7 on outlet.
11. Operating Key(s): Two with each loose-key-operation wall hydrant.

## 2.8 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AMTROL, Inc.
  - b. Josam Company.
  - c. MIFAB, Inc.
  - d. PPP Inc.
  - e. Sioux Chief Manufacturing Company, Inc.
  - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - g. Tyler Pipe; Wade Div.
  - h. Watts Drainage Products Inc.
  - i. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows or Copper tube with piston sized in accordance with PDI WH-201, factory precharged suitable for operation in temperature range of minus 33 to 300 degrees F and maximum working pressure 250 pounds per square inch-gage.
4. Watts No. 15 or approved equal.

## 2.9 AIR VENTS

- A. Bolted-Construction Automatic Air Vents:
  - 1. Body: Bronze.
  - 2. Pressure Rating: 125-psig minimum pressure rating at 140 deg F.
  - 3. Float: Replaceable, corrosion-resistant metal.
  - 4. Mechanism and Seat: Stainless steel.
  - 5. Size: NPS 1/2 minimum inlet.
  - 6. Inlet and Vent Outlet End Connections: Threaded.
  
- B. Welded-Construction Automatic Air Vents:
  - 1. Body: Stainless steel.
  - 2. Pressure Rating: 150-psig minimum pressure rating.
  - 3. Float: Replaceable, corrosion-resistant metal.
  - 4. Mechanism and Seat: Stainless steel.
  - 5. Size: NPS 3/8 minimum inlet.
  - 6. Inlet and Vent Outlet End Connections: Threaded.

## 2.10 TRAP-SEAL PRIMER SYSTEMS

- A. Trap-Seal Primer Valves (Type TP-A):
  - 1. Manufacturers: Subject to compliance with requirements, provide product as called out on the Drawings or similar products as manufactured by one of the following:
    - a. MIFAB, Inc.
    - b. PPP Inc.
    - c. Sioux Chief Manufacturing Company, Inc.
    - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    - e. Watts Industries, Inc.; Water Products Div.
  - 2. Standard: ASSE 1018.
  - 3. Pressure Rating: 125 psig minimum.
  - 4. Body: Bronze.
  - 5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
  - 6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.
  - 7. Trap primer assembly shall be complete with trap primer valve and distribution unit sized for the number of floor drains primed by the assembly. The trap primer valve shall have an integral vacuum breaker and shall automatically activate upon a drop in water pressure in the water supply line.
  
- B. Trap Primer Assembly – Electronic (Type TP-B):
  - 1. Manufacturers: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by another manufacturer.
  - 2. Standard: ASSE 1044,
  - 3. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.
  - 4. Cabinet: Surface-mounting steel box with stainless-steel cover.
  - 5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
  - 6. Vacuum Breaker: ASSE 1001.
  - 7. Number Outlets: As required per Plumbing Drawings.

8. Size Outlets: NPS 1/2.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
  1. Locate backflow preventers in same room as connected equipment or system.
  2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
  3. Do not install bypass piping around backflow preventers.
- C. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
- D. Install water control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.
- E. Install balancing valves in locations where they can easily be adjusted.
- F. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
  1. Install thermometers and water regulators if specified.
  2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- G. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve and solenoid valve.
- H. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."
- I. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.
  1. Install shutoff valve on outlet if specified.
  2. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."

- J. Install ground hydrants with a minimum of one cubic yard (1cu. yd.) of crushed gravel around drain hole. Set ground hydrants with box flush with grade.
- K. Install draining type post hydrants with a minimum of one cubic yard (1cu.yd) of crushed gravel around drain hole. Set post hydrants in concrete paving or in one cubic foot (1cu. ft.) of concrete block at grade.
- L. Install nonfreeze, nondraining-type post hydrants set in concrete or pavement.
- M. Install freeze-resistant yard hydrants with riser pipe set in concrete or pavement. Do not encase canister in concrete.
- N. Install water hammer arresters in water piping according to PDI-WH 201.
- O. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.
- P. Install supply-type, trap seal primer valves with outlet piping pitched down toward drain trap a minimum of one percent (1%), and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- Q. Install water hammer arresters complete with accessible isolation valve.
- R. Install water hammer arresters on hot and cold water lines at the end of each battery of plumbing fixtures and at each plumbing fixture which is located remote from a battery of fixtures, unless noted otherwise on Drawings.
- S. Provide trap primers in cold water lines for traps as shown on Drawings. Tap trap primers off the top of the domestic water supply line.

### 3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install equipment nameplate or signs on or near each of the following:
  - 1. Pressure vacuum breakers.
  - 2. Reduced-pressure-principle backflow preventers.
  - 3. Water pressure-reducing valves.
  - 4. Calibrated balancing valves.

5. Primary, thermostatic, water mixing valves.
6. Manifold, thermostatic, water-mixing-valve assemblies.
7. Primary water tempering valves.
8. Outlet boxes.
9. Hose stations.
10. Trap primer valves.
11. Trap-primer systems.

- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer and double-check backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

### 3.5 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION

## SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

### 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. Copper building wire rated 600 V or less.
  - 2. Metal-clad cable, Type MC, rated 600 V or less.
  - 3. Armored cable, Type AC, rated 600 V or less.
  - 4. Fire-alarm wire and cable.
  - 5. Connectors, splices, and terminations rated 600 V and less.

#### 1.3 DEFINITIONS

- A. VFC: Variable-frequency controller.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: Indicate type, use, location, and termination locations.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer's authorized service representative.
- B. Field quality-control reports.

#### 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA.
  - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

## PART 2 - PRODUCTS

### 2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- 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. General Cable Technologies Corporation.
  - 2. Okonite Company (The).
  - 3. Southwire Company.
- C. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. RoHS compliant.
  - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- E. Conductor Insulation:
  - 1. Type THHN and Type THWN-2: Comply with UL 83.
  - 2. Type XHHW-2: Comply with UL 44.

### 2.2 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- 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. 3M Electrical Products.
  - 2. Ideal Industries, Inc.
  - 3. ILSCO.
  - 4. O-Z/Gedney; a brand of Emerson Industrial Automation.
  - 5. Thomas & Betts Corporation; A Member of the ABB Group.
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
  - 1. Material: Copper.
  - 2. Type: Two hole with long barrels.
  - 3. Termination: Compression.



## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.
- C. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.
- D. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type XHHW-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.
- E. Feeders Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.
- F. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
- H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.
- I. Branch Circuits Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.
- J. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- K. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- L. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

- M. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- N. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- O. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."
- P. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

### 3.3 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
  - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

### 3.4 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor. Identify as spare conductor.

### 3.5 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."

### 3.6 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

### 3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

- B. Perform tests and inspections.
1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
  2. Perform each of the following visual and electrical tests:
    - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    - b. Test bolted connections for high resistance using one of the following:
      - 1) A low-resistance ohmmeter.
      - 2) Calibrated torque wrench.
      - 3) Thermographic survey.
    - c. Inspect compression-applied connectors for correct cable match and indentation.
    - d. Inspect for correct identification.
    - e. Inspect cable jacket and condition.
    - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
    - g. Continuity test on each conductor and cable.
    - h. Uniform resistance of parallel conductors.
  3. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
    - a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    - b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
  4. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
- C. Cables will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports to record the following:
1. Procedures used.
  2. Results that comply with requirements.
  3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

## SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL 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.

#### 1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
- B. Section includes grounding and bonding systems and equipment, plus the following special applications:
  - 1. Underground distribution grounding.
  - 2. Ground bonding common with lightning protection system.
  - 3. Foundation steel electrodes.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
  - 1. Test wells.
  - 2. Ground rods.
  - 3. Ground rings.
  - 4. Grounding arrangements and connections for separately derived systems.
- B. Qualification Data: For testing agency and testing agency's field supervisor.
- C. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Plans showing as-built, dimensioned locations of system described in "Field Quality Control" Article, including the following:
      - 1) Test wells.

- 2) Ground rods.
  - 3) Ground rings.
  - 4) Grounding arrangements and connections for separately derived systems.
- b. Instructions for periodic testing and inspection of grounding features at test wells, ground rings, grounding connections for separately derived systems based on NETA MTS.
- 1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
  - 2) Include recommended testing intervals.

## 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Certified by NETA.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- 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. Comply with UL 467 for grounding and bonding materials and equipment.

### 2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advanced Lightning Technology, Ltd.
  2. Burndy; Part of Hubbell Electrical Systems.
  3. ERICO; a brand of nVent.
  4. Harger Lightning & Grounding.
  5. ILSCO.
  6. O-Z/Gedney; a brand of Emerson Industrial Automation.
  7. Robbins Lightning, Inc.
  8. Thomas & Betts Corporation; A Member of the ABB Group.

### 2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
1. Solid Conductors: ASTM B3.
  2. Stranded Conductors: ASTM B8.
  3. Tinned Conductors: ASTM B33.

4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
  5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
  7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V. CONNECTORS
- D. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- E. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- F. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- G. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.
- H. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- I. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- J. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
- K. Conduit Hubs: Mechanical type, terminal with threaded hub.
- L. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- M. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.  
nbm
- N. Lay-in Lug Connector: Mechanical type, aluminum or copper rated for direct burial terminal with set screw.
- O. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.
- P. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
- Q. Straps: Braided copper, cast-bronze clamp. Rated for 600 A.
- R. Tower Ground Clamps: Mechanical type, copper or copper alloy, terminal one-piece clamp.
- S. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

- T. Water Pipe Clamps:
  - 1. Mechanical type, two pieces with zinc-plated bolts.
    - a. Material: Die-cast zinc alloy.
    - b. Listed for direct burial.
  - 2. U-bolt type with malleable-iron clamp and copper ground connector.

## 2.4 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet.
- B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.
  - 1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches long.
  - 2. Backfill Material: Electrode manufacturer's recommended material.
- C. Ground Plates: 1/4 inch thick, hot-dip galvanized.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
  - 1. Bury at least 30 inches below grade.
  - 2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- C. Grounding Conductors: Green-colored insulation with continuous yellow stripe.
- D. Isolated Grounding Conductors: Green-colored insulation with more than one continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- E. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
  - 1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 60 inches above finished floor unless otherwise indicated.
  - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- F. 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.

### 3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

### 3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

### 3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

### 3.5 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
  1. Feeders and branch circuits.
  2. Lighting circuits.
  3. Receptacle circuits.
  4. Single-phase motor and appliance branch circuits.



5. Three-phase motor and appliance branch circuits.
  6. Flexible raceway runs.
  7. Armored and metal-clad cable runs.
  8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
  9. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- G. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
- H. Metallic Fences: Comply with requirements of IEEE C2.
1. Grounding Conductor: Bare copper, not less than No. 8 AWG.
  2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
  3. Barbed Wire: Strands shall be bonded to the grounding conductor.

### 3.6 FENCE GROUNDING

- A. Fence Grounding: Install at maximum intervals of 1500 feet except as follows:
1. Fences within 100 Feet (30 m) of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet.
    - a. Gates and Other Fence Openings: Ground fence on each side of opening.
      - 1) Bond metal gates to gate posts.
      - 2) Bond across openings, with and without gates, except at openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches below finished grade.

- B. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of 150 feet on each side of crossing.
- C. Fences Enclosing Electrical Power Distribution Equipment: Ground as required by IEEE C2 unless otherwise indicated.
- D. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.
- E. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.
- F. Bonding to Lightning-Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning-protection down conductor or lightning-protection grounding conductor, complying with NFPA 780.

### 3.7 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
  - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
  - 2. Use exothermic welds for all below-grade connections.
  - 3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.
  - 1. Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
  3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- F. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
  2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
  3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.
- I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column indicated, extending around the perimeter of building or area or item indicated.
1. Install tinned-copper conductor not less than No. 4/0 AWG for ground ring and for taps to building steel.
  2. Bury ground ring not less than 24 inches from building's foundation.
- J. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.
1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
  2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.
- K. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 feet long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.
- L. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
  2. Make connections with clean, bare metal at points of contact.

3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

### 3.8 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 test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
- D. Tests and Inspections:
  1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells. Make tests at ground rods before any conductors are connected.
    - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    - b. Perform tests by fall-of-potential method according to IEEE 81.
  4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- E. Grounding system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Report measured ground resistances that exceed the following values:
  1. Power and Lighting Equipment or System with Capacity to 1000 kVA: 5 ohms.
  2. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
- H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

## SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL 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.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Steel slotted support systems.
  - 2. Aluminum slotted support systems.
  - 3. Nonmetallic slotted support systems.
  - 4. Conduit and cable support devices.
  - 5. Support for conductors in vertical conduit.
  - 6. Structural steel for fabricated supports and restraints.
  - 7. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
  - 8. Fabricated metal equipment support assemblies.

#### 1.3 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. Sockets.
    - e. Eye nuts.
    - f. Fasteners.
    - g. Anchors.
    - h. Saddles.
    - i. Brackets.
  - 2. Include rated capacities and furnished specialties and accessories.
- B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.
  - 1. Hangers. Include product data for components.
  - 2. Slotted support systems.
  - 3. Equipment supports.

4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  1. Flame Rating: Class 1.
  2. Self-extinguishing according to ASTM D635.

### 2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch- diameter holes at a maximum of 8 inches o.c. in at least one surface.
  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. CADDY; a brand of nVent.
    - c. Thomas & Betts Corporation; A Member of the ABB Group.
    - d. Super Strut
    - e. Unistrut; Part of Atkore International.
  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. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
  7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Aluminum Slotted Support Systems: Extruded-aluminum channels and angles with minimum 13/32-inch- diameter holes at a maximum of 8 inches o.c. in at least one surface.
  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. Cooper Industries, Inc.
    - b. Thomas & Betts Corporation; A Member of the ABB Group.
    - c. Unistrut; Part of Atkore International.
  2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  3. Channel Material: 6063-T5 aluminum alloy.
  4. Fittings and Accessories Material: 5052-H32 aluminum alloy.

5. Channel Width: Selected for applicable load criteria.
  6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
  7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with minimum 13/32-inch- diameter holes at a maximum of 8 inches o.c., in at least one surface.
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. G-Strut.
  2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  3. Channel Width: Selected for applicable load criteria.
  4. Fittings and Accessories: Products provided by channel and angle manufacturer and designed for use with those items.
  5. Fitting and Accessory Materials: Same as those for channels and angles, except metal items may be stainless steel.
  6. Rated Strength: Selected to suit applicable load criteria.
  7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical 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.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.
- G. 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) Red Head

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) Hilti, Inc.
    - 3) ITW Ramset/Red Head; Illinois Tool Works, Inc.
    - 4) Red Head
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 F3125/F3125.
6. Toggle Bolts: All steel springhead type.
7. Hanger Rods: Threaded steel.

### 2.3 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

### 3.1 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 101
  3. NECA 102.
  4. NECA 105.
  5. 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 raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.



- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted 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.
- F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

### 3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT and] RMC may be supported by openings through structure members, according to NFPA 70.
- C. 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.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical 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: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  - 4. To Existing Concrete: 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 thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
  - 6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
  - 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.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

### 3.3 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 electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

### 3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base as follows:
  - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

### 3.5 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.
- B. Touchup: Comply with requirements in Section 099113 "Exterior Painting", Section 099123 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 260529

## SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL 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.

#### 1.2 SUMMARY

- A. Section Includes:
  1. Metal conduits and fittings.
  2. Nonmetallic conduits and fittings.
  3. Metal wireways and auxiliary gutters.
  4. Nonmetal wireways and auxiliary gutters.
  5. Surface raceways.
  6. Boxes, enclosures, and cabinets.
  7. Handholes and boxes for exterior underground cabling.
- B. Related Requirements:
  1. Section 078413 "Penetration Firestopping" for firestopping at conduit and box entrances.
  2. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
  3. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

#### 1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

## PART 2 - PRODUCTS

### 2.1 METAL CONDUITS AND FITTINGS

#### A. Metal Conduit:

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. AFC Cable Systems; a part of Atkore International.
  - b. Allied Tube & Conduit; a part of Atkore International.
  - c. Electri-Flex Company.
  - d. O-Z/Gedney; a brand of Emerson Industrial Automation.
  - e. Perma-Cote.
2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. GRC: Comply with ANSI C80.1 and UL 6.
4. ARC: Comply with ANSI C80.5 and UL 6A.
5. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
  - a. Comply with NEMA RN 1.
  - b. Coating Thickness: 0.040 inch , minimum.
6. EMT: Comply with ANSI C80.3 and UL 797.
7. FMC: Comply with UL 1; zinc-coated steel.
8. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

#### B. Metal Fittings:

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. AFC Cable Systems; a part of Atkore International.
  - b. Allied Tube & Conduit; a part of Atkore International.
  - c. Anamet Electrical, Inc.
  - d. Electri-Flex Company.
  - e. O-Z/Gedney; a brand of Emerson Industrial Automation.
2. Comply with NEMA FB 1 and UL 514B.
3. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. Fittings, General: Listed and labeled for type of conduit, location, and use.
5. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
6. Fittings for EMT:
  - a. Material: Steel.
  - b. Type: compression.
7. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
8. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

- C. Joint Compound for 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.

## 2.2 NONMETALLIC CONDUITS AND FITTINGS

### A. Nonmetallic Conduit:

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. CANTEX INC.
  - b. Carlon.
  - c. CertainTeed Corporation.
2. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. ENT: Comply with NEMA TC 13 and UL 1653.
4. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
5. LFNC: Comply with UL 1660.
6. Rigid HDPE: Comply with UL 651A.
7. Continuous HDPE: Comply with UL 651A.
8. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D3485.
9. RTRC: Comply with UL 2515A and NEMA TC 14.

### B. Nonmetallic Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. CANTEX INC.
  - b. Carlon.
  - c. CertainTeed Corporation.
2. Fittings, General: Listed and labeled for type of conduit, location, and use.
3. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
  - a. Fittings for LFNC: Comply with UL 514B.
4. Solvents and Adhesives: As recommended by conduit manufacturer.

## 2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

### A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. B-line, an Eaton business.
2. Hoffman; a brand of nVent.
3. Square D.

### B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1, Type 3R, Type 4 unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

#### 2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- 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. Hoffman; a brand of nVent.
- B. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.
- D. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- E. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- F. Solvents and Adhesives: As recommended by conduit manufacturer.

#### 2.5 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
  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:
  2. Hubbell Incorporated; Wiring Device-Kellems.
    - a. MonoSystems, Inc.
    - b. Wiremold / Legrand.

- C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Hubbell Incorporated.
    - b. MonoSystems, Inc.
    - c. Panduit Corp.
    - d. Wiremold / Legrand.
  
- D. Tele-Power Poles:
  - 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. MonoSystems, Inc.
    - b. Wiremold / Legrand.
  - 2. Material: Aluminum with clear anodized finish.
  - 3. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

## 2.6 BOXES, ENCLOSURES, 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. Crouse-Hinds, an Eaton business.
  - 2. EGS/Appleton Electric.
  - 3. FSR Inc.
  - 4. Hoffman; a brand of nVent.
  - 5. Hubbell Incorporated.
  
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
  
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
  
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
  
- E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
  
- F. Metal Floor Boxes:
  - 1. Material: Cast metal or sheet metal.
  - 2. Type: Fully adjustable or Semi-adjustable.
  - 3. Shape: Rectangular.
  - 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- G. Nonmetallic Floor Boxes: Nonadjustable, rectangular.
  - 1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- H. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- I. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb (32 kg).
  - 1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- J. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- K. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- L. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- M. Device Box Dimensions: 4 inches square by 2-1/8 inches deep or 4 inches by 2-1/8 inches by 2-1/8 inches deep.
- N. Gangable boxes are allowed.
- O. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1, Type 3R or Type 4 with continuous-hinge cover with flush latch unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  - 2. Nonmetallic Enclosures: Fiberglass.
  - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- P. Cabinets:
  - 1. NEMA 250, Type 1 or Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  - 2. Hinged door in front cover with flush latch and concealed hinge.
  - 3. Key latch to match panelboards.
  - 4. Metal barriers to separate wiring of different systems and voltage.
  - 5. Accessory feet where required for freestanding equipment.
  - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. General Requirements for Handholes and Boxes:
  - 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.



2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
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. Oldcastle Precast, Inc.
  2. Standard: Comply with SCTE 77.
  3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
  4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
  5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  6. Cover Legend: Molded lettering, "ELECTRIC."
  7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
  8. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.
- C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete.
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. Nordic Fiberglass, Inc.
    - b. Oldcastle Enclosure Solutions.
    - c. Quazite: Hubbell Power Systems, Inc.
  2. Standard: Comply with SCTE 77.
  3. Color of Frame and Cover: Gray.
  4. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
  5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
  6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  7. Cover Legend: Molded lettering, "ELECTRIC."
  8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
  9. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

## 2.8 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Tests of materials shall be performed by an independent testing agency.

2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
  1. Exposed Conduit: GRC, PVC coated.
  2. Concealed Conduit, Aboveground: GRC.
  3. Underground Conduit: RNC, Type EPC-40-PVC or Type EPC-80-PVC, direct buried or concrete encased.
  4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R or Type 4.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
  1. Exposed, Not Subject to Physical Damage: EMT.
  2. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
    - a. Loading dock.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - c. Mechanical rooms.
    - d. Gymnasiums.
  3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  5. Damp or Wet Locations: GRC.
  6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways 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. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
  3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
  4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- G. Install surface raceways only where indicated on Drawings.
- H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

### 3.2 INSTALLATION

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
- D. Do not fasten conduits onto the bottom side of a metal deck roof.
- E. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Complete raceway installation before starting conductor installation.
- G. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- J. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- K. Support conduit within 12 inches of enclosures to which attached.
- L. Raceways Embedded in Slabs:
  - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
  - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

3. Arrange raceways to keep a minimum of 1 inch of concrete cover in all directions.
  4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
  5. Change from ENT to GRC before rising above floor.
- M. Stub-Ups to Above Recessed Ceilings:
1. Use EMT or RMC for raceways.
  2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- O. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- P. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- Q. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- R. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- S. 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.
- T. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- U. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- V. Surface Raceways:
1. Install surface raceway with a minimum 2-inch radius control at bend points.
  2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- W. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, 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 raceway sealing fittings according to NFPA 70.

- X. Install devices to seal raceway 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 raceways at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where an underground service raceway enters a building or structure.
  - 3. Conduit extending from interior to exterior of building.
  - 4. Conduit extending into pressurized duct and equipment.
  - 5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
  - 6. Where otherwise required by NFPA 70.
  
- Y. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
  
- Z. Expansion-Joint Fittings:
  - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
  - 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 temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    - d. Attics: 135 deg F 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 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 of temperature change for metal conduits.
  - 4. Install expansion fittings at all locations where conduits cross building or structure expansion 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.
  
- AA. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
  - 1. Use LFMC in damp or wet locations subject to severe physical damage.
  - 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
  
- BB. 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.
  
- CC. 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 surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

- DD. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- EE. Locate boxes so that cover or plate will not span different building finishes.
- FF. 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.
- GG. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- HH. Set metal floor boxes level and flush with finished floor surface.
- II. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

### 3.3 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 less than 6 inches 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 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.
5. Install manufactured PVC coated rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
  - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches 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 from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

### 3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.
- E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

### 3.5 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."

### 3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.7 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and 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 260533

## SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL 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.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Metal conduits and fittings, including GRC and PVC-coated steel conduit.
  - 2. Rigid nonmetallic duct.
  - 3. Flexible nonmetallic duct.
  - 4. Duct accessories.
  - 5. Precast concrete handholes.
  - 6. Polymer concrete handholes and boxes with polymer concrete cover.
  - 7. Fiberglass handholes and boxes with polymer concrete cover.
  - 8. Fiberglass handholes and boxes.
  - 9. High-density plastic boxes.
  - 10. Precast manholes.
  - 11. Cast-in-place manholes.

#### 1.3 DEFINITIONS

- A. Direct Buried: Duct or a duct bank that is buried in the ground, without any additional casing materials such as concrete.
- B. Duct: A single duct or multiple ducts. Duct may be either installed singly or as component of a duct bank.
- C. Duct Bank:
  - 1. Two or more ducts installed in parallel, with or without additional casing materials.
  - 2. Multiple duct banks.
- D. GRC: Galvanized rigid (steel) conduit.
- E. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include duct-bank materials, including spacers and miscellaneous components.



2. Include duct, conduits, and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
3. Include accessories for manholes, handholes and boxes.
4. Include underground-line warning tape.
5. Include warning planks.

B. Shop Drawings:

1. Precast or Factory-Fabricated Underground Utility Structures:
  - a. Include plans, elevations, sections, details, attachments to other work, and accessories.
  - b. Include duct entry provisions, including locations and duct sizes.
  - c. Include reinforcement details.
  - d. Include frame and cover design and manhole chimneys.
  - e. Include ladder details.
  - f. Include grounding details.
  - g. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
  - h. Include joint details.
2. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:
  - a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
  - b. Include duct entry provisions, including locations and duct sizes.
  - c. Include cover design.
  - d. Include grounding details.
  - e. Include dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

1.6 FIELD CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary electrical service according to requirements indicated:
1. Notify Owner no fewer than five days in advance of proposed interruption of electrical service.
  2. Do not proceed with interruption of electrical service without Owner's written permission.
- B. Ground Water: Assume ground-water level is 36 inches below ground surface unless a higher water table is noted on Drawings.

## PART 2 - PRODUCTS

### 2.1 METAL CONDUIT AND FITTINGS

- A. GRC: Comply with ANSI C80.1 and UL 6.
- B. Coated Steel Conduit: PVC-coated GRC.
  - 1. Comply with NEMA RN 1.
  - 2. Coating Thickness: 0.040 inch, minimum.
- C. 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. Allied Tube & Conduit; a part of Atkore International.
  - 2. Electri-Flex Company.
  - 3. O-Z/Gedney; a brand of Emerson Industrial Automation.
  - 4. Perma-Cote.
- D. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

### 2.2 RIGID NONMETALLIC DUCT

- A. Underground Plastic Utilities Duct: Type EPC-80-PVC and Type EPC-40-PVC RNC, complying with NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by same manufacturer as duct.
- B. Underground Plastic Utilities Duct: Type DB-60 PVC and Type DB-120 PVC RNC, complying with NEMA TC 6 & 8 and ASTM F512 for direct burial, with matching fittings complying with NEMA TC 9 by same manufacturer as duct.
- C. Underground Plastic Utilities Duct: Type EB-20 PVC RNC, complying with NEMA TC 6 & 8, ASTM F512, and UL 651, with matching fittings complying with NEMA TC 9 by same manufacturer as duct.
- D. 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. Allied.
  - 2. Carlon.
  - 3. CertainTeed Corporation.
- E. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
- F. Solvents and Adhesives: As recommended by conduit manufacturer.

## 2.3 FLEXIBLE NONMETALLIC DUCTS

- A. HDPE Duct: Type EPEC-40 HDPE or Type EPEC-80 HDPE, complying with NEMA TC 7 and UL 651A.
  - 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. Carlon; a brand of Thomas & Betts Corporation.
    - b. National Pipe & Plastics.
    - c. Opti-Com Manufacturing Network, Inc (OMNI).
  - 2. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

## 2.4 DUCT ACCESSORIES

- A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.
- B. Underground-Line Warning Tape: Comply with requirements for underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."
- C. Concrete Warning Planks: Nominal 12 by 3 inches in size, manufactured from 6000-psi concrete.
  - 1. Color: Red dye added to concrete during batching.
  - 2. Mark each plank with "ELECTRIC" in 2-inch- high, 3/8-inch- deep letters.

## 2.5 PRECAST CONCRETE HANDHOLES AND BOXES

- A. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.
- 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. Oldcastle Precast, Inc.
- C. Comply with ASTM C858 for design and manufacturing processes.
- D. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
- E. Frame and Cover: Weatherproof steel frame, with steel cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
- F. Frame and Cover: Weatherproof steel frame, with hinged steel access door assembly with tamper-resistant, captive, cover-securing bolts.
  - 1. Cover Hinges: Concealed, with hold-open ratchet assembly.

2. Cover Handle: Recessed.
- G. Frame and Cover: Weatherproof aluminum frame with hinged aluminum access door assembly with tamper-resistant, captive, cover-securing bolts.
    1. Cover Hinges: Concealed, with hold-open ratchet assembly.
    2. Cover Handle: Recessed.
  - H. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  - I. Cover Legend: Molded lettering, "ELECTRIC".
  - J. Configuration: Units shall be designed for flush burial and have integral closed bottom unless otherwise indicated.
  - K. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
    1. Extension shall provide increased depth of 12 inches.
    2. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.
  - L. 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.
  - M. Knockout Panels: Precast openings in walls, arranged to match dimensions and elevations of approaching duct, plus an additional 12 inches vertically and horizontally to accommodate alignment variations.
    1. Center window location.
    2. Knockout panels shall be located no less than 6 inches from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
    3. Knockout panel opening shall have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct.
    4. Knockout panels shall be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
    5. Knockout panels shall be 1-1/2 to 2 inches thick.
  - N. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
    1. Type and size shall match fittings to duct to be terminated.
    2. Fittings shall align with elevations of approaching duct and be located near interior corners of handholes to facilitate racking of cable.
  - O. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.
- 2.6 POLYMER CONCRETE HANDHOLES AND BOXES WITH POLYMER CONCRETE COVER
- A. Description: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.

- 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. Oldcastle Enclosure Solutions.
- C. Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
- D. Color: Gray.
- E. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.
- F. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
- G. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- H. Cover Legend: Molded lettering, "ELECTRIC".
- I. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
- J. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering duct for secure, fixed installation in enclosure wall.
- K. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.

## 2.7 FIBERGLASS HANDHOLES AND BOXES WITH POLYMER CONCRETE FRAME AND COVER

- A. Description: Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.
- 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. Oldcastle Enclosure Solutions.
  - 2. Quazite: Hubbell Power Systems, Inc.
- C. Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
- D. Color: Gray.
- E. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.

- F. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
- G. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- H. Cover Legend: Molded lettering, "ELECTRIC".
- I. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
- J. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering duct for secure, fixed installation in enclosure wall.
- K. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.

## 2.8 PRECAST MANHOLES

- A. Description: One-piece units and units with interlocking mating sections, complete with accessories, hardware, and features.
- 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. Oldcastle Precast, Inc.
- C. Comply with ASTM C858.
- D. Structural Design Loading: Comply with requirements in "Underground Enclosure Application" Article.
- E. Knockout Panels: Precast openings in walls, arranged to match dimensions and elevations of approaching duct, plus an additional 12 inches (300 mm) vertically and horizontally to accommodate alignment variations.
  - 1. Center window location.
  - 2. Knockout panels shall be located no less than 6 inches (150 mm) from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
  - 3. Knockout panel opening shall have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie into concrete envelopes of duct.
  - 4. Knockout panel shall be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
  - 5. Knockout panels shall be 1-1/2 to 2 inches thick.
- F. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
  - 1. Type and size shall match fittings to duct to be terminated.
  - 2. Fittings shall align with elevations of approaching duct and be located near interior corners of manholes to facilitate racking of cable.

- G. Ground Rod Sleeve: Provide a 3-inch PVC sleeve in manhole floors 2 inches (50 mm) from the wall adjacent to, but not underneath, the duct entering the structure.
- H. 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.

## 2.9 UTILITY STRUCTURE ACCESSORIES

- A. Accessories for Utility Structures: Utility equipment and accessory items used for utility structure access and utility support, listed and labeled for intended use and application.
- B. Manhole Sump Frame and Grate: ASTM A 48/A 48M, Class 30B, gray cast iron.
- C. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch-diameter eye, and 1-by-4-inch bolt.
  - 1. Working Load Embedded in 6-Inch 4000-psi Concrete: 13,000-lbf minimum tension.
- D. Pulling-in and Lifting Irons in Concrete Floors: 7/8-inch-diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.
  - 1. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.
- E. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch ID by 2-3/4 inches deep, flared to 1-1/4 inches minimum at base.
  - 1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.
- F. Ground Rod Sleeve: 3-inch PVC sleeve in manhole floors 2 inches from the wall adjacent to, but not underneath, the ducts routed from the facility.
- G. Cable Rack Assembly: Nonmetallic. Components fabricated from nonconductive, fiberglass-reinforced polymer.
  - 1. Stanchions: Nominal 36 inches high by 4 inches wide, with minimum of nine holes for arm attachment.
  - 2. Arms: Arranged for secure, drop-in attachment in horizontal position at any location on cable stanchions, and capable of being locked in position. Arms shall be available in lengths ranging from 3 inches with 450-lb minimum capacity to 20 inches with 250-lb minimum capacity. Top of arm shall be nominally 4 inches wide, and arm shall have slots along full length for cable ties.
- H. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F. Capable of withstanding temperature of 300 deg F without slump and adhering to clean surfaces of plastic ducts, metallic conduit, conduit and duct coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.
- I. Fixed Manhole Ladders: Arranged for attachment to roof and floor of manhole. Ladder and mounting brackets and braces shall be fabricated from nonconductive, structural-grade, fiberglass-reinforced resin.

- J. Cover Hooks: Heavy duty, designed for lifts 60 lbf and greater. Two required.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of duct and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to manholes and handholes, and as approved by Architect.
- C. Clear and grub vegetation to be removed, and protect vegetation to remain according to Section 311000 "Site Clearing." Remove and stockpile topsoil for reapplication according to Section 311000 "Site Clearing."

#### 3.2 UNDERGROUND DUCT APPLICATION

- A. Duct for Electrical Cables More Than 600 V: Type EPC-80-PVC RNC, concrete-encased unless otherwise indicated.
- B. Duct for Electrical Feeders 600 V and Less: Type EPC-80-PVC, Type EPC-40-PVC or Type EB-20-PVC RNC, concrete-encased unless otherwise indicated.
- C. Duct for Electrical Branch Circuits: Type EPC-40-PVC RNC, direct-buried unless otherwise indicated.
- D. Bored Underground Duct: Type EPEC-40-HDPE or Type EPEC-80-HDPE unless otherwise indicated.
- E. Underground Ducts Crossing Driveways, Roadways and Railroads: Type EPC-40 PVC RNC, encased in reinforced concrete.
- F. Stub-ups: Concrete-encased PVC-coated GRC.

#### 3.3 UNDERGROUND ENCLOSURE APPLICATION

- A. Handholes and Boxes for 600 V and Less:
  - 1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.



2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, H-**20** structural load rating.
3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, H-10 or Polymer concrete units, Tier 8 structural load rating.
4. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin structurally tested according to SCTE 77 with 3000-lb vertical loading.
5. Cover design load shall not exceed the design load of the handhole or box.

B. Manholes: Precast concrete.

1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.
2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

### 3.4 EARTHWORK

- A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restoration: Replace area immediately after backfilling is completed.
- C. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- D. 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 Section 329200 "Turf and Grasses" and Section 329300 "Plants."
- E. Cut and patch existing pavement in the path of underground duct, duct bank, and underground structures according to "Cutting and Patching" Article in Section 017300 "Execution."

### 3.5 DUCT AND DUCT-BANK INSTALLATION

- A. Install duct, spacers, and accessories into the duct-bank. Duct installation requirements in this Section also apply to duct bank.
- B. Install duct according to NEMA TCB 2.
- C. Slope: Pitch duct a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope duct from a high point between two manholes, to drain in both directions.
- D. 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.
  1. Duct shall have maximum of three 90 degree bends or the total of all bends shall be no more 270 degrees between pull points.

- E. Joints: Use solvent-cemented joints in duct and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent duct do not lie in same plane.
- F. End Bell Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch duct, and vary proportionately for other duct sizes.
  - 1. Begin change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell, without reducing duct slope and without forming a trap in the line.
  - 2. Expansion and Deflection Fittings: Install an expansion and deflection fitting in each duct in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight line direct-buried duct with calculated expansion of more than 3/4 inch.
  - 3. Grout end bells into structure walls from both sides to provide watertight entrances.
- G. Terminator Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use manufactured, cast-in-place duct terminators, with entrances into structure spaced approximately 6 inches o.c. for 4-inch duct, and vary proportionately for other duct sizes.
  - 1. Begin change from regular spacing to terminator spacing 10 feet from the terminator, without reducing duct line slope and without forming a trap in the line.
  - 2. Expansion and Deflection Fittings: Install an expansion and deflection fitting in each duct in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight line duct with calculated expansion of more than 3/4 inch.
- H. Building Wall Penetrations: Make a transition from underground duct to GRC at least 10 feet outside the building wall, without reducing duct line slope away from the building and without forming a trap in the line. Use fittings manufactured for RNC-to-GRC transition. Install GRC penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- I. Sealing: Provide temporary closure at terminations of duct with pulled cables. Seal spare duct at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- J. Pulling Cord: Install 200-lbf- test nylon cord in empty ducts.
- K. Concrete-Encased Ducts and Duct Bank:
  - 1. Excavate trench bottom to provide firm and uniform support for duct. Prepare trench bottoms as specified in Section 312000 "Earth Moving" for pipes less than 6 inches (150 mm) in nominal diameter.
  - 2. Width: Excavate trench minimum 3 inches wider than duct on each side.
  - 3. Depth: Install so top of duct envelope is at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 30 inches below finished grade in deliberate traffic paths for vehicles unless otherwise indicated.
  - 4. Support duct on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
  - 5. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than four spacers per 20 feet of duct. Place spacers within 24 inches of duct ends. Stagger spacers approximately 6 inches between tiers. Secure spacers to

- earth and to duct to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
6. Minimum Space between Duct: 3 inches between edge of duct and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and communications ducts.
  7. Elbows: Use manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct unless otherwise indicated. Extend encasement throughout length of elbow.
  8. Elbows: Use manufactured PVC coated GRC elbows for stub-ups, at building entrances, and at changes of direction in duct run.
    - a. Couple RNC duct to GRC with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
    - b. Stub-ups to Outdoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.
      - 1) Stub-ups shall be minimum 4 inches above finished floor and minimum 3 inches from conduit side to edge of slab.
    - c. Stub-ups to Indoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches from edge of wall. Install insulated grounding bushings on terminations at equipment.
      - 1) Stub-ups shall be minimum 4 inches above finished floor and no less than 3 inches from conduit side to edge of slab.
  9. Reinforcement: Reinforce concrete-encased duct where crossing disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
  10. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
  11. Concrete Cover: Install a minimum of 3 inches of concrete cover between edge of duct to exterior envelope wall, 2 inches between duct of like services, and 4 inches between power and communications ducts.
  12. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
    - a. Start at one end and finish at the other, allowing for expansion and contraction of duct as its temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written instructions, or use other specific measures to prevent expansion-contraction damage.
    - b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing-rod dowels extending a minimum of 18 inches into concrete on both sides of joint near corners of envelope.
  13. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between duct and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Allow concrete to flow around duct and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-installation application.

L. Direct-Buried Duct:

1. Excavate trench bottom to provide firm and uniform support for duct. Comply with requirements in Section 312000 "Earth Moving" for preparation of trench bottoms for pipes less than 6 inches in nominal diameter.
2. Width: Excavate trench 3 inches wider than duct on each side.
3. Depth: Install top of duct at least 24 inches below finished grade unless otherwise indicated.
4. Elbows: Install manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct direction unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured PVC coated GRC elbows for stub-ups, at building entrances.
  - a. Couple RNC duct to GRC with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
  - b. Stub-ups to Outdoor Equipment:
    - 1) Stub-ups shall be minimum 4 inches above finished slab and minimum 3 inches from conduit side to edge of slab.
  - c. Stub-ups to Indoor Equipment: Install insulated grounding bushings on terminations at equipment.
    - 1) Stub-ups shall be minimum 4 inches finished floor and no less than 3 inches from conduit side to edge of slab.

### 3.6 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

- A. Precast Concrete Handhole and Manhole Installation:
  1. Comply with ASTM C891 unless otherwise indicated.
  2. Install units level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances.
  3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- B. Elevations:
  1. Manhole Roof: Install with rooftop at least 15 inches below finished grade.
  2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch above finished grade.
  3. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch above finished grade.
  4. Where indicated, cast handhole cover frame integrally with handhole structure.
- C. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.
- D. Manhole Access: Circular opening in manhole roof; sized to match cover size.
  1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
  2. Install chimney, constructed of precast concrete collars and rings, to support cast-iron frame to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for frame to chimney.

- E. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, as required for installation and support of cables and conductors and as indicated.
- F. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.
- G. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches for manholes and 2 inches for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

### 3.7 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of duct, and seal joint between box and extension as recommended by manufacturer.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
- D. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.
- E. Field cut openings for duct according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

### 3.8 GROUNDING

- A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

### 3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.
  - 2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 12-inch-long mandrel equal to duct size minus 1/4 inch. If obstructions are indicated, remove obstructions and retest.

3. Test manhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

C. Prepare test and inspection reports.

### 3.10 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump.

1. Sweep floor, removing dirt and debris.
2. Remove foreign material.

END OF SECTION 260543

## SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

### 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 for raceway and cable penetration of non-fire-rated construction walls and floors.
  - 2. Sleeve-seal systems.
  - 3. Sleeve-seal fittings.
  - 4. Grout.
  - 5. Silicone sealants.
- B. Related Requirements:
  - 1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

### PART 2 - PRODUCTS

#### 2.1 SLEEVES

- A. Wall Sleeves:
  - 1. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
  - 2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. PVC-Pipe Sleeves: ASTM D1785, Schedule 40.

- D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Sleeves for Rectangular Openings:
  - 1. Material: Galvanized sheet steel.
  - 2. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
    - b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

## 2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advance Products & Systems, Inc.
    - b. Flexicraft Industries.
    - c. Metraflex Company (The).
    - d. Proco Products, Inc.
  - 2. Sealing Elements: EPDM rubber 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.
  - 4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

## 2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
  - 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. HOLDRITE; Reliance Worldwide Company.

## 2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.



- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## 2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
  - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

## PART 3 - EXECUTION

### 3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
  - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
    - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
    - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
  - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed
  - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
  - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
  - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe 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.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

### 3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.3 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.

END OF SECTION 260544

## SECTION 260553 - IDENTIFICATION FOR ELECTRICAL 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.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Color and legend requirements for raceways, conductors, and warning labels and signs.
  - 2. Labels.
  - 3. Bands and tubes.
  - 4. Tapes and stencils.
  - 5. Tags.
  - 6. Signs.
  - 7. Cable ties.
  - 8. Paint for identification.
  - 9. Fasteners for labels and signs.

#### 1.3 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 electrical identification products.
- B. Delegated-Design Submittal: For arc-flash hazard study.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Comply with NFPA 70E requirements for arc-flash warning labels.

- F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- G. 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 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
  - 1. Orange letters on a black background.
  - 2. Legend: Indicate voltage, system and service type.
  - 3. Example:
    - a. 480VAC/ 3PH
    - b. 60HZ
    - c. LIGHTING AND POWER
- B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
  - 1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG.
  - 2. Colors for 208/120-V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.
  - 3. Colors for 240-V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
  - 4. Colors for 480/277-V Circuits:
    - a. Phase A: Brown.
    - b. Phase B: Purple.
    - c. Phase C: Yellow.
  - 5. Color for Neutral: White or gray.
  - 6. Color for Equipment Grounds: Green.
  - 7. Colors for Isolated Grounds: Green with two or more yellow stripes.
- C. Raceways and Cables Carrying Circuits at More Than 600 V:
  - 1. Black letters on an orange field.
  - 2. Legend: "DANGER - HIGH VOLTAGE WIRING."
- D. Warning Label Colors:
  - 1. Identify system voltage with black letters on an orange background.
- E. Warning labels and signs shall include, but are not limited to, the following legends:
  - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
- F. Equipment Identification Labels:
  - 1. Black letters on a white background.
  - 2. Include equipment designation 1/4"H.

3. Include source and circuit number 1/8"H.

## 2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
  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. Brady Corporation.
    - b. Panduit Corp.
- B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
  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. Brady Corporation.
    - b. Panduit Corp.
- C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-thick, vinyl flexible label with acrylic pressure-sensitive adhesive.
  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. Brady Corporation.
    - b. Panduit Corp.
  2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
  3. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
- D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil- thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
  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. Brady Corporation.
    - b. Panduit Corp.
  2. Minimum Nominal Size:
    - a. 1-1/2 by 6 inches for raceway and conductors.
    - b. 3-1/2 by 5 inches for equipment.

## 2.4 BANDS AND TUBES

- A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters and that stay in place by gripping action.
  - 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. Brady Corporation.
    - b. Panduit Corp.

## 2.5 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
  - 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. Ideal Industries, Inc.
    - b. Panduit Corp.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.
  - 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. Brady Corporation.
- C. Underground-Line Warning Tape:
  - 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. Brady Corporation.
    - b. Ideal Industries, Inc.
  - 2. Tape:
    - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical utility lines.
    - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
    - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
  - 3. Color and Printing:
    - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
    - b. Inscriptions for Red-Colored Tapes: "CAUTION ELECTRIC LINE

## 2.6 TAGS

- A. Metal Tags for use in Vaults, Manholes and Handholes: Brass, stainless steel or aluminum, 2 by 2 by 0.05 inch with stamped legend, punched for use with self-locking cable tie fastener.

## 2.7 SIGNS

- A. Laminated Acrylic Signs:
  - 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. Brady Corporation.
  - 2. Engraved legend.
  - 3. Thickness:
    - a. For signs up to 20 sq. in., minimum 1/16 inch thick.
    - b. For signs larger than 20 sq. in., 1/8 inch thick.
    - c. Engraved legend with white letters on black background.
    - d. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.
    - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

## 2.8 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength at 73 Deg F according to ASTM D638: 12,000 psi.
  - 3. Temperature Range: Minus 40 to plus 185 deg F.
  - 4. Color: Black, except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength at 73 Deg F according to ASTM D638: 12,000 psi.
  - 3. Temperature Range: Minus 40 to plus 185 deg F.
  - 4. Color: Black.
- C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength at 73 Deg F according to ASTM D638: 7000 psi.
  - 3. UL 94 Flame Rating: 94V-0.
  - 4. Temperature Range: Minus 50 to plus 284 deg F.
  - 5. Color: Black.

## 2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

### 3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
  - 1. Secure tight to surface of conductor, cable, or raceway.
- H. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
  - 1. Secure tight to surface of conductor, cable, or raceway.
- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.



- J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.
- K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- L. Accessible Fittings for Raceways: Paint the covers of each junction and pull box of the following systems as follows:
  - 1. Emergency – Yellow.
  - 2. Fire Alarm – Red.
- M. Vinyl Wraparound Labels:
  - 1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
  - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- N. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.
- O. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.
- P. Self-Adhesive Labels:
  - 1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
  - 2. Unless otherwise indicated, provide a text with 1/2-inch-high letters on 1-1/2-inch- or 2-inch high label.
- Q. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- R. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- S. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
  - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- T. Underground Line Warning Tape:
  - 1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
  - 2. Limit use of underground-line warning tape to direct-buried cables.
  - 3. Install underground-line warning tape for direct-buried cables and cables in raceways.
- U. Metal Tags:
  - 1. Place in a location with high visibility and accessibility.

2. Secure using general-purpose cable ties.

V. Laminated Acrylic Signs:

1. Attach signs that are not self-adhesive type with stainless steel or brass screws.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high sign; where two lines of text are required, use labels 2 inches high.

W. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

### 3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil. Stencil legend "DANGER - HIGH-VOLTAGE WIRING" with 3-inch-high, black letters on 20-inch centers.
  1. Locate identification at changes in direction, at penetrations of walls and floors, and at 30-foot maximum intervals.
- D. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Vinyl wraparound labels.
  1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- E. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.
  1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- F. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box with panel and circuit number in indelible ink.
- G. Power-Circuit Conductor Identification, 600 V or Less: For conductors in pull and junction boxes, use vinyl self-adhesive wraparound labels to identify the phase and circuit designation.
  1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- H. Power-Circuit Conductor Identification for conductors in vaults, manholes, and handholes, use metal tags to indicate phase, and circuit designation.

- I. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.
- J. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with the conductor designation.
- K. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- L. Auxiliary Electrical Systems Conductor Identification: Marker tape that is uniform and consistent with system used by manufacturer for factory-installed connections.
  - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
- M. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- N. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- O. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
  - 1. Apply to exterior of door, cover, or other access.
  - 2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
    - a. Power-transfer switches.
    - b. Controls with external control power connections.
- P. Arc Flash Warning Labeling: Self-adhesive labels.
- Q. Operating Instruction Signs: Laminated acrylic signs.
- R. Emergency Operating Instruction Signs: Laminated acrylic signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.
- S. Equipment Identification Labels:
  - 1. Indoor Equipment: Laminated acrylic nameplates.
  - 2. Outdoor Equipment: Laminated acrylic nameplates.
  - 3. Equipment to Be Labeled:
    - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a engraved laminated acrylic nameplate.
    - b. Enclosures and electrical cabinets.
    - c. Access doors and panels for concealed electrical items.
    - d. Switchgear.
    - e. Switchboards.
    - f. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    - g. Substations.

- h. Emergency system boxes and enclosures.
- i. Motor-control centers.
- j. Enclosed switches.
- k. Enclosed circuit breakers.
- l. Enclosed controllers.
- m. Variable-speed controllers.
- n. Push-button stations.
- o. Power-transfer equipment.
- p. Contactors.
- q. Remote-controlled switches, dimmer modules, and control devices.
- r. Battery-inverter units.
- s. Battery racks.
- t. Power-generating units.
- u. Monitoring and control equipment.
- v. UPS equipment.

END OF SECTION 260553

## SECTION 260573.13 - SHORT-CIRCUIT 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 a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective 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 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 Systems 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 may be in digital form.
  - a. Short-circuit study input data, including completed computer program input data sheets.
  - b. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.
    - 1) 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.
    - 2) Revised one-line diagram, reflecting field investigation results and results of short-circuit study.

#### 1.5 INFORMATIONAL SUBMITTALS

##### A. Qualification Data:

1. For Power Systems Analysis Software Developer.
2. For Power System Analysis Specialist.
3. For Field Adjusting Agency.

B. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

#### 1.6 CLOSEOUT SUBMITTALS

##### A. Operation and Maintenance Data:

1. For overcurrent protective devices to include in emergency, operation, and maintenance manuals.
2. The following are from the Short-Circuit Study Report:
  - a. Final one-line diagram.
  - b. Final Short-Circuit Study Report.
  - c. Short-circuit study data files.
  - d. Power system data.

#### 1.7 QUALITY ASSURANCE

- A. Study 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.

1. Power System Analysis Software Qualifications: Computer program shall be designed to perform short-circuit studies or have a function, component, or add-on module designed to perform short-circuit 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.
- D. 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.
- E. Short-Circuit Study Certification: Short-Circuit Study Report shall be signed and sealed by Power Systems Analysis Specialist.
- F. Field Adjusting Agency Qualifications:
1. Employer of a NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification 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. 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. SKM Systems Analysis, Inc.
- B. Comply with IEEE 399 and IEEE 551.
1. Analytical features of power systems analysis software program shall have 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.

### 2.2 SHORT-CIRCUIT 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 and ratings.
  6. Derating factors and environmental conditions.
  7. Any revisions to electrical equipment required by the study.
- D. Comments and recommendations for system improvements or revisions in a written document, separate from one-line diagram.
- E. Protective Device Evaluation:
1. Evaluate equipment and protective devices and compare to available short-circuit currents. Verify that equipment withstand ratings exceed available short-circuit current at equipment installation locations.
  2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
  3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
  4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in standards to 1/2-cycle symmetrical fault current.
  5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
- F. Short-Circuit Study Input Data:
1. One-line diagram of system being studied.
  2. Power sources available.
  3. Manufacturer, model, and interrupting rating of protective devices.
  4. Conductors.
  5. Transformer data.
- G. Short-Circuit Study Output Reports:
1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
    - a. Voltage.
    - b. Calculated fault-current magnitude and angle.
    - c. Fault-point X/R ratio.
    - d. Equivalent impedance.
  2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
    - a. Voltage.
    - b. Calculated symmetrical fault-current magnitude and angle.
    - c. Fault-point X/R ratio.
    - d. Calculated asymmetrical fault currents:
      - 1) Based on fault-point X/R ratio.
      - 2) Based on calculated symmetrical value multiplied by 1.6.
      - 3) Based on calculated symmetrical value multiplied by 2.7.
  3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
    - a. Voltage.
    - b. Calculated symmetrical fault-current magnitude and angle.
    - c. Fault-point X/R ratio.



- d. No AC Decrement (NACD) ratio.
- e. Equivalent impedance.
- f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
- g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

## PART 3 - EXECUTION

### 3.1 POWER SYSTEM DATA

- A. Obtain all data necessary for conduct of the study.
  1. Verify completeness of data supplied on one-line diagram. 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 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 the required input data to support the short-circuit study. Comply with requirements in Section 017839 "Project Record Documents" for recording circuit protective device characteristics. Record data on a Record Document copy of one-line diagram. Comply with recommendations in IEEE 551 as to the amount of detail that is 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 Project's overcurrent protective devices 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. Obtain electrical power utility impedance at the service.
  3. Power sources and ties.
  4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
  5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
  6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
  7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
  8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
  9. Motor horsepower and NEMA MG 1 code letter designation.
  10. Conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
  11. Derating factors.

### 3.2 SHORT-CIRCUIT STUDY

- A. Perform study following the general study procedures contained in IEEE 399.
- B. Calculate short-circuit currents according to IEEE 551.
- 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 short-circuit current 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. Exclude 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. 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 the fault-current dc decrement to address asymmetrical requirements of interrupting equipment.
- H. 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.
- I. Include in the report identification of any protective device applied outside its capacity.

END OF SECTION 260573.13

## SECTION 260573.16 - 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 may 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. 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. SKM Systems Analysis, Inc.
- B. Comply with IEEE 242 and IEEE 399.
- C. 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.
- D. 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 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. Exclude 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 MOTOR-STARTING STUDY

- A. Perform a motor-starting study to analyze the transient effect of system's voltage profile during motor starting. Calculate significant motor-starting voltage profiles and analyze the effects of motor starting on the power system stability.
- B. Prepare the motor-starting study report, noting light flicker for limits proposed by IEEE 141, and voltage sags so as not to affect operation of other utilization equipment on system supplying the motor.

### 3.6 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 short-circuit and 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.

### 3.7 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 260573.16

## SECTION 260573.19 - ARC-FLASH HAZARD ANALYSIS

### 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 a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

#### 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.
- 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 Systems 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 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: For computer software program to be used for studies.
- B. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals may be in digital form:
  - 1. Arc-flash study input data, including completed computer program input data sheets.
  - 2. Arc-flash study report; signed, dated, and sealed by Power Systems Analysis Specialist.
  - 3. 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 Systems Analysis Software Developer.
  - 2. For Power System Analysis Specialist.
  - 3. For Field Adjusting Agency.
- B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:
  - 1. Provide maintenance procedures in equipment manuals according to requirements in NFPA 70E.
  - 2. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

#### 1.7 QUALITY ASSURANCE

- A. Study 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: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
  - 1. Computer program shall be designed to perform arc-flash analysis or have a function, component, or add-on module designed to perform arc-flash analysis.

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 in charge of performing the arc-flash study, analyzing the arc flash, and documenting recommendations, 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. Arc-Flash Study Certification: Arc-Flash Study Report shall be signed and sealed by Power Systems Analysis Specialist.
- G. Field Adjusting Agency Qualifications:
  1. Employer of a NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification 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 COMPUTER SOFTWARE DEVELOPERS

- 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. SKM Systems Analysis, Inc.
- B. Comply with IEEE 1584 and NFPA 70E.
- C. 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.

### 2.2 ARC-FLASH STUDY REPORT CONTENT

- 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, showing the following:
  1. Protective device designations and ampere ratings.
  2. Conductor types, sizes, and lengths.
  3. Transformer kilovolt ampere (kVA) and voltage ratings, including derating factors and environmental conditions.
  4. Motor and generator designations and kVA ratings.
  5. Switchgear, switchboard, motor-control center, panelboard designations, and ratings.

- D. Study Input Data: As described in "Power System Data" Article.
- E. Short-Circuit Study Output Data: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
- F. Protective Device Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."
- G. Arc-Flash Study Output Reports:
  - 1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in the report:
    - a. Voltage.
    - b. Calculated symmetrical fault-current magnitude and angle.
    - c. Fault-point X/R ratio.
    - d. No AC Decrement (NACD) ratio.
    - e. Equivalent impedance.
    - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
    - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.
- H. Incident Energy and Flash Protection Boundary Calculations:
  - 1. Arcing fault magnitude.
  - 2. Protective device clearing time.
  - 3. Duration of arc.
  - 4. Arc-flash boundary.
  - 5. Restricted approach boundary.
  - 6. Limited approach boundary.
  - 7. Working distance.
  - 8. Incident energy.
  - 9. Hazard risk category.
  - 10. Recommendations for arc-flash energy reduction.
- I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of computer printout.

### 2.3 ARC-FLASH WARNING LABELS

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis.
- B. Label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
  - 1. Location designation.
  - 2. Nominal voltage.
  - 3. Protection boundaries.
    - a. Arc-flash boundary.
    - b. Restricted approach boundary.

- c. Limited approach boundary.
  - 4. Arc flash PPE category.
  - 5. Required minimum arc rating of PPE in Cal/cm squared.
  - 6. Available incident energy.
  - 7. Working distance.
  - 8. Engineering report number, revision number, and issue date.
- C. Labels shall be machine printed, with no field-applied markings.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

#### 3.2 ARC-FLASH HAZARD ANALYSIS

- A. Comply with NFPA 70E and its Annex D for hazard analysis study.
- B. Preparatory Studies: Perform the Short-Circuit and Protective Device Coordination study studies prior to starting the Arc-Flash Hazard Analysis.
  - 1. 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."
  - 2. Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."
- C. Calculate maximum and minimum contributions of fault-current size.
  - 1. Maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
  - 2. Calculate arc-flash energy at 85 percent of maximum short-circuit current according to IEEE 1584 recommendations.
  - 3. Calculate arc-flash energy at 38 percent of maximum short-circuit current according to NFPA 70E recommendations.
  - 4. Calculate arc-flash energy with the utility contribution at a minimum and assume no motor contribution.
- D. Calculate the arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.
- E. Include medium- and low-voltage equipment locations, except equipment rated 240 V ac or less fed from transformers less than 125 kVA.
- F. Calculate the limited, restricted, and prohibited approach boundaries for each location.



- G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
  - 1. Fault contribution from induction motors shall not be considered beyond three to five cycles.
  - 2. Fault contribution from synchronous motors and generators shall be decayed to match the actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).
- H. Arc-flash energy shall generally be reported for the maximum of line or load side of a circuit breaker. However, arc-flash computation shall be performed and reported for both line and load side of a circuit breaker as follows:
  - 1. When the circuit breaker is in a separate enclosure.
  - 2. When the line terminals of the circuit breaker are separate from the work location.
- I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

### 3.3 POWER SYSTEM DATA

- A. Obtain all data necessary for conduct of the arc-flash hazard analysis.
  - 1. Verify completeness of data supplied on one-line diagram on Drawings and under "Preparatory Studies" Paragraph in "Arc-Flash Hazard Analysis" Article. Call discrepancies to Architect's attention.
  - 2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.
  - 3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers.
- B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the 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. Obtain electrical power utility impedance or available short circuit current 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. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
13. Motor horsepower and NEMA MG 1 code letter designation.
14. Low-voltage conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
15. Medium-voltage conductor sizes, lengths, conductor material, conductor construction and metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).

### 3.4 LABELING

- A. Apply one arc-flash label on the front cover for each equipment included in the study. Base arc-flash label data on highest values calculated at each location.
- B. Each piece of equipment listed below shall have an arc-flash label applied to it:
  1. Motor-control center.
  2. Low-voltage switchboard.
  3. Switchgear.
  4. Medium-voltage switch.
  5. Medium voltage transformers
  6. Low voltage transformers. Exclude transformers with high voltage side 240 V or less and less than 125 kVA.
  7. Panelboard and safety switch over 250 V.
  8. Applicable panelboard and safety switch under 250 V.
  9. Control panel.
- C. Note on record Drawings the location of equipment where the personnel could be exposed to arc-flash hazard during their work.
  1. Indicate arc-flash energy.
  2. Indicate protection level required.

### 3.5 APPLICATION OF WARNING LABELS

- A. Install arc-flash warning labels under the direct supervision and control of Power System Analysis Specialist.

3.6 DEMONSTRATION

- A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in potential arc-flash hazards associated with working on energized equipment and the significance of arc-flash warning labels.

END OF SECTION 260573.19

## SECTION 262416 - 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.

#### 1.3 DEFINITIONS

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. HID: High-intensity discharge.
- E. MCCB: Molded-case circuit breaker.
- F. SPD: Surge protective device.
- G. VPR: Voltage protection rating.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
  - 1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
  - 2. 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.
  - 2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
  - 3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.

4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of NRTL listing for SPD as installed in panelboard.

#### 1.5 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 Section 017823 "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.

#### 1.6 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. Keys: Two spares for each type of panelboard cabinet lock.
  2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.

#### 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Handle and prepare panelboards for installation according to NEMA PB 1.

#### 1.9 FIELD 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 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 minus 22 deg F to plus 104 deg F.
- B. 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 Owner no fewer than two 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.

#### 1.10 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
  1. Panelboard Warranty Period: 18 months from date of Substantial Completion.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.
  1. SPD Warranty Period: Five years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 PANELBOARD COMMON 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. Comply with NEMA PB 1.
- C. Comply with NFPA 70.
- D. Enclosures: Flush or Surface-mounted, dead-front 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 or 4X as indicated on drawings.
    - c. Wash-Down Areas: NEMA 250, Type 4X.
    - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4X.
  2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
  3. Finishes:
    - a. Panels and Trim: galvanized 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: Same finish as panels and trim.
    - c.
- E. Incoming Mains:
  1. Location: Top or Bottom.
  2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.
- F. Phase, Neutral, and Ground Buses:
  1. Material: Hard-drawn copper, 98 percent conductivity.
    - a. Plating shall run entire length of bus.

- b. Bus shall be fully rated the entire length.
  2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
  3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
  4. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
  5. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled by an NRTL acceptable to authority having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings as "NL". Connectors shall be sized for double-sized or parallel conductors as indicated on Drawings. Do not mount neutral bus in gutter.
- G. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Hard-drawn copper, 98 percent conductivity.
  2. Terminations shall allow use of 75 deg C rated conductors without derating.
  3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
  4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard. Provide main lugs to accommodate T&B compression connector on end of cable.
  5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
  6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
  7. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- H. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- I. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
  2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1.

## 2.3 POWER PANELBOARDS

- 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. Eaton.
  - 2. General Electric Company; GE Energy Management - Electrical Distribution.
  - 3. Siemens Industry, Inc., Energy Management Division.
  - 4. Square D; by Schneider Electric.
- B. Panelboards: NEMA PB 1, 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: Circuit breaker or Lugs only.
- 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.
  - 1.

## 2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- 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. General Electric Company; GE Energy Management - Electrical Distribution.
  - 2. Siemens Industry, Inc., Energy Management Division.
  - 3. Square D; by Schneider Electric.
- 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: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

## 2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- 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. Eaton.



2. General Electric Company; GE Energy Management - Electrical Distribution.
  3. Siemens Industry, Inc., Energy Management Division.
  4. Square D; by Schneider Electric.
- B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers:
    - a. Inverse time-current element for low-level overloads.
    - b. Instantaneous magnetic trip element for short circuits.
    - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  3. Electronic Trip Circuit Breakers:
    - a. RMS sensing.
    - b. Field-replaceable rating plug or electronic trip.
    - c. Digital display of settings, trip targets, and indicated metering displays.
    - d. Multi-button keypad to access programmable functions and monitored data.
    - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
    - f. Integral test jack for connection to portable test set or laptop computer.
    - g. Field-Adjustable Settings:
      - 1) Instantaneous trip.
      - 2) Long- and short-time pickup levels.
      - 3) Long and short time adjustments.
      - 4) Ground-fault pickup level, time delay, and I squared T response.
  4. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
  5. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
  6. Subfeed Circuit Breakers: Vertically mounted.
  7. MCCB Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Breaker handle indicates tripped status.
    - c. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    - d. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
    - e. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    - f. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
    - g. Multipole units factory assembled to operate as a single unit.
    - h. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

## 2.6 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

- C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder.
  - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards according to NECA 407.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- 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. Comply with NECA 1.
- C. Install panelboards and accessories according to NECA 407.
- D. Equipment Mounting:
  - 1. Install floor mounted panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete".
  - 2. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- F. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- G. Mount panelboard cabinet plumb and rigid without distortion of box.

- H. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- I. Install overcurrent protective devices and controllers not already factory installed.
  - 1. Set field-adjustable, circuit-breaker trip ranges.
  - 2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- J. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- K. Install filler plates in unused spaces.
- L. Stub four 1-inch empty conduits from flush mounted panelboard into accessible ceiling space or space designated to be ceiling space in the future.

### 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in power distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

### 3.4 FIELD QUALITY CONTROL

- A. 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 for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit

Breakers and Paragraph 7.19.1 Surge Arrestors, Low-Voltage. Perform optional tests. 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, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.
  1. Measure loads during period of normal facility operations.
  2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
  3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
  4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

END OF SECTION 262416

## SECTION 262726 - WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  1. Standard-grade receptacles, 125 V, 20 A.
  2. USB receptacles.
  3. GFCI receptacles, 125 V, 20 A.
  4. Twist-locking receptacles.
  5. Toggle switches, 120/277 V, 20 A.
  6. Decorator-style devices, 20 A.
  7. Occupancy sensors.
  8. Wall-box dimmers.
  9. Wall plates.
  10. Floor service fittings.
  11. Poke-through assemblies.
  12. Prefabricated multioutlet assemblies.
  13. Service poles.

#### 1.3 DEFINITIONS

- A. AFCI: Arc-fault circuit interrupter.
- B. BAS: Building automation system.
- C. EMI: Electromagnetic interference.
- D. GFCI: Ground-fault circuit interrupter.
- E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- F. RFI: Radio-frequency interference.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

#### 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.

### PART 2 - PRODUCTS

#### 2.1 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Comply with NFPA 70.
- C. RoHS compliant.
- D. Comply with NEMA WD 1.
  - 1. Cord and Plug Sets: Match equipment requirements.
- E. Device Color:
  - 1. Wiring Devices Connected to Normal Power System: White unless otherwise indicated or required by NFPA 70 or device listing.
  - 2. Wiring Devices Connected to Essential Electrical System: Red.
- F. Wall Plate Color: For plastic covers, match device color.
- G. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

#### 2.2 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

- A. Duplex Receptacles, 125 V, 20 A:

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. Hubbell Incorporated; Wiring Device-Kellems.
    - b. Leviton Manufacturing Co., Inc.
    - c. Pass & Seymour/Legrand (Pass & Seymour).
  2. Description: Two pole, three wire, and self-grounding.
  3. Configuration: NEMA WD 6, Configuration 5-20R.
  4. Standards: Comply with UL 498 and FS W-C-596.
- B. Weather-Resistant Duplex Receptacle, 125 V, 20 A:
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. Hubbell Incorporated; Wiring Device-Kellems.
    - b. Leviton Manufacturing Co., Inc.
    - c. Pass & Seymour/Legrand (Pass & Seymour).
  2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
  3. Configuration: NEMA WD 6, Configuration 5-20R.
  4. Standards: Comply with UL 498.
  5. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.

## 2.3 USB RECEPTACLES

- A. USB Charging Receptacles:
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. Hubbell Incorporated; Wiring Device-Kellems.
    - b. Leviton Manufacturing Co., Inc.
    - c. Pass & Seymour/Legrand (Pass & Seymour).
  2. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
  3. USB Receptacles: Dual, USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).
  4. Standards: Comply with UL 1310 and USB 3.0 devices.

## 2.4 GFCI RECEPTACLES, 125 V, 20 A

- A. Duplex GFCI Receptacles, 125 V, 20 A:
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. Hubbell Incorporated; Wiring Device-Kellems.
    - b. Leviton Manufacturing Co., Inc.
  2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.

3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Type: Non-feed through.
5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

## 2.5 TWIST-LOCKING RECEPTACLES

### A. Twist-Lock, Single Receptacles, 120 V, 20 A:

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. Hubbell Incorporated; Wiring Device-Kellems.
  - b. Leviton Manufacturing Co., Inc.
  - c. Pass & Seymour/Legrand (Pass & Seymour).
2. Configuration: NEMA WD 6, Configuration L5-20R.
3. Standards: Comply with UL 498.

### B. Twist-Lock, Single Receptacles, 250 V, 20 A:

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. Hubbell Premise Wiring.
  - b. Leviton Manufacturing Co., Inc.
  - c. Pass & Seymour/Legrand (Pass & Seymour).
2. Configuration: NEMA WD 6, Configuration L6-20R.
3. Standards: Comply with UL 498.

## 2.6 TOGGLE SWITCHES, 120/277 V, 20 A

### A. Single-Pole Switches, 120/277 V, 20 A:

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. Hubbell Incorporated; Wiring Device-Kellems.
  - b. Leviton Manufacturing Co., Inc.
  - c. Pass & Seymour/Legrand (Pass & Seymour).
2. Standards: Comply with UL 20 and FS W-S-896.

### B. Two-Pole Switches, 120/277 V, 20 A:

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. Hubbell Incorporated; Wiring Device-Kellems.
  - b. Leviton Manufacturing Co., Inc.
  - c. Pass & Seymour/Legrand (Pass & Seymour).
2. Comply with UL 20 and FS W-S-896.

### C. Three-Way Switches, 120/277 V, 20 A:



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. Hubbell Incorporated; Wiring Device-Kellems.
    - b. Leviton Manufacturing Co., Inc.
    - c. Pass & Seymour/Legrand (Pass & Seymour).
  2. Comply with UL 20 and FS W-S-896.
- D. Four-Way Switches, 120/277 V, 20 A:
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. Hubbell Incorporated; Wiring Device-Kellems.
    - b. Leviton Manufacturing Co., Inc.
    - c. Pass & Seymour/Legrand (Pass & Seymour).
  2. Standards: Comply with UL 20 and FS W-S-896.
- E. Key-Operated, Single-Pole Switches, 120/277 V, 20 A:
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. Hubbell Incorporated; Wiring Device-Kellems.
    - b. Leviton Manufacturing Co., Inc.
    - c. Pass & Seymour/Legrand (Pass & Seymour).
  2. Description: Factory-supplied key in lieu of switch handle.
  3. Standards: Comply with UL 20 and FS W-S-896.
- 2.7 DECORATOR-STYLE DEVICES, 20 A
- A. Decorator Duplex Receptacles, 125 V, 20 A:
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. Hubbell Incorporated; Wiring Device-Kellems.
    - b. Leviton Manufacturing Co., Inc.
    - c. Pass & Seymour/Legrand (Pass & Seymour).
  2. Description: Two pole, three wire, and self-grounding. Square face.
  3. Configuration: NEMA WD 6, Configuration 5-20R.
  4. Standards: Comply with UL 498.
- B. Decorator Single-Pole Switches, 120/277 V, 20 A:
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. Hubbell Incorporated; Wiring Device-Kellems.
    - b. Leviton Manufacturing Co., Inc.
    - c. Pass & Seymour/Legrand (Pass & Seymour).
  2. Comply with UL 20.

## 2.8 OCCUPANCY SENSORS

- A. Wall Switch Sensor Light Switch, Dual Technology:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Hubbell Incorporated; Wiring Device-Kellems.
    - b. Leviton Manufacturing Co., Inc.
    - c. Pass & Seymour/Legrand (Pass & Seymour).
    - d. Wattstopper.
  2. Description: Switchbox-mounted, combination lighting-control sensor and conventional switch lighting-control unit using dual (ultrasonic and passive infrared) technology.
  3. Standards: Comply with UL 20.
  4. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
  5. Adjustable time delay of 20 minutes.
  6. Able to be locked to Automatic-On mode.
  7. Connections: Provisions for connection to BAS.

## 2.9 DIMMERS

- A. Wall-Box Dimmers:
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. Hubbell Incorporated; Wiring Device-Kellems.
    - b. Leviton Manufacturing Co., Inc.
    - c. Lutron Electronics Co., Inc.
    - d. Pass & Seymour/Legrand (Pass & Seymour).
  2. Description: Modular, full-wave, solid-state dimmer switch with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
  3. Control: Continuously adjustable slider; with single-pole or three-way switching.
  4. Standards: Comply with UL 1472.
  5. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.
  6. LED Lamp Dimmer Switches: Modular; compatible with LED lamps; trim potentiometer to adjust low-end dimming; capable of consistent dimming with low end not greater than 20 percent of full brightness.

## 2.10 WALL PLATES

- A. Single Source: Obtain wall plates from same manufacturer of wiring devices.
- B. Single and combination types shall match corresponding wiring devices.
1. Plate-Securing Screws: Metal with head color to match plate finish.
  2. Material for Finished Spaces: Smooth, high-impact nylon, or satin-finished, Type 302 stainless steel 0.04-inch-thick for Essential Electrical System.
  3. Material for Unfinished Spaces: Galvanized steel.

- C. Wet-Location, Weatherproof While-In-Use Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover. Hubbell WP26E vertical, WP26EH horizontal.

## 2.11 FLOOR SERVICE FITTINGS

### A. Flush-Type Floor Service Fittings:

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. Hubbell Premise Wiring.
  - b. Thomas & Betts Corporation; A Member of the ABB Group.
  - c. Wiremold / Legrand.
2. Description: Type: Modular, flush-type, dual-service units suitable for wiring method used, with cover flush with finished floor.
3. Compartments: Barrier separates power from voice and data communication cabling.
4. Service Plate and Cover: Rectangular or Round, die-cast aluminum with satin finish.
5. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.
6. Data Communication Outlet: Blank cover with bushed cable opening.

### B. Above-Floor Service Fittings:

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. Hubbell Premise Wiring.
  - b. Thomas & Betts Corporation; A Member of the ABB Group.
  - c. Wiremold / Legrand.
2. Description: Type: Modular, above-floor, dual-service units suitable for wiring method used.
3. Compartments: Barrier separates power from voice and data communication cabling.
4. Service Plate: Rectangular, die-cast aluminum with satin finish.
5. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.
6. Data Communication Outlet: Blank cover with bushed cable opening.

## 2.12 POKE-THROUGH ASSEMBLIES

- A. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
- 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. Pass & Seymour/Legrand (Pass & Seymour).
  2. Square D; by Schneider Electric.
  3. Wiremold / Legrand.

- C. Standards: Comply with scrub water exclusion requirements in UL 514.
- D. Service-Outlet Assembly: Flush type with two simplex receptacles and space for two RJ-45 jacks, complying with requirements in Section 271513 "Communications Copper Horizontal Cabling."
- E. Size: Selected to fit nominal 3 or 4-inch cored holes in floor and matched to floor thickness.
- F. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
- G. Closure Plug: Arranged to close unused 3-inch or 4-inch cored openings and reestablish fire rating of floor.
- H. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of four, four-pair cables that comply with requirements in Section 271513 "Communications Copper Horizontal Cabling."

#### 2.13 PREFABRICATED MULTIOUTLET ASSEMBLIES

- A. Description: Two-piece surface metal raceway, with factory-wired multioutlet harness.
- 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. Hubbell Incorporated; Wiring Device-Kellems.
  - 2. Wiremold / Legrand.
- C. Components shall be products from single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- D. Raceway Material: Metal, with manufacturer's standard finish.
- E. Multioutlet Harness:
  - 1. Receptacles: 15-A, 125-V, NEMA WD 6 Configuration 5-15R receptacles complying with NEMA WD 1, UL 498, and FS W-C-596.
  - 2. Receptacle Spacing: 12 inches.
  - 3. Wiring: No. 12 AWG solid, Type THHN copper, single circuit or two circuit, connecting alternating receptacles.

#### 2.14 SERVICE POLES

- A. Dual-Channel Service Poles:
  - 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. Hubbell Premise Wiring.
    - b. Panduit Corp.

2. Description: Factory-assembled and -wired units to extend power and voice and data communication from distribution wiring concealed in ceiling to devices or outlets in pole near floor.
3. Poles: Nominal 2.5-inch- square cross-section, with height adequate to extend from floor to at least 6 inches above ceiling, and with separate channels for power wiring and voice and data communication cabling.
4. Mounting: Ceiling trim flange with concealed bracing arranged for positive connection to ceiling supports; with pole foot and carpet pad attachment.
5. Material: Aluminum.
6. Finishes: Satin-anodized aluminum.
7. Wiring: Sized for minimum of five No. 12 AWG power and ground conductors and a minimum of four, balanced twisted pair data communication cables.
8. Power Receptacles: Two duplex, 20-A, straight-blade receptacles complying with requirements in this Section.
9. Data Communication Outlets: Blank insert with bushed cable opening.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
  1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
  2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
  3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
  4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
  1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
  2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
  3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.
  4. Existing Conductors:
    - a. Cut back and pigtail, or replace all damaged conductors.
    - b. Straighten conductors that remain and remove corrosion and foreign matter.
    - c. Pigtail existing conductors is permitted, provided the outlet box is large enough.
- D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
  2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
  3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
  4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
  5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
  6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
  7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
  8. Tighten unused terminal screws on the device.
  9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the left.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Dimmers:
1. Install dimmers within terms of their listing.
  2. Verify that dimmers used for fan-speed control are listed for that application.
  3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions.
- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on bottom. Group adjacent switches under single, multigang wall plates.
- I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.
- 3.2 GFCI RECEPTACLES
- A. Install non-feed-through GFCI receptacles.
- 3.3 IDENTIFICATION
- A. Comply with Section 260553 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate for normal building power,

red-filled lettering on face of Essential Electrical System receptacles, and durable wire markers or tags inside outlet boxes.

### 3.4 FIELD QUALITY CONTROL

- A. Test Instruments: Use instruments that comply with UL 1436.
- B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- C. Perform the following tests and inspections:
  - 1. Test Instruments: Use instruments that comply with UL 1436.
  - 2. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- D. Tests for Receptacles:
  - 1. Line Voltage: Acceptable range is 105 to 132 V.
  - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
  - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
  - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
  - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
  - 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- E. Wiring device will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 262726

## SECTION 262813 - FUSES

### 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. Cartridge fuses rated 600 V ac and less for use in the following:
    - a. Control circuits.
    - b. Motor-control centers.
    - c. Panelboards.
    - d. Switchboards.
    - e. Enclosed controllers.
    - f. Enclosed switches.
  - 2. Spare-fuse cabinets.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
  - 1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
  - 2. Current-limitation curves for fuses with current-limiting characteristics.
  - 3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in PDF format.
  - 4. Coordination charts and tables and related data.
  - 5. Fuse sizes for elevator feeders and elevator disconnect switches.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  - 1. Current-limitation curves for fuses with current-limiting characteristics.
  - 2. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. in PDF format.



3. Coordination charts and tables and related data.

## 1.5 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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- 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. Bussmann, an Eaton business.
  2. Littelfuse, Inc.
- B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

### 2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
  1. Type RK-5: 250 or 600-V, zero- to 600-A rating, 200 kAIC, time delay.
  2. Type J: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
  3. Type L: 600-V, 601- to 6000-A rating, 200 kAIC, time delay.
- B. 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.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

### 2.3 SPARE-FUSE CABINET

- A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
  1. Size: Adequate for storage of spare fuses specified.
  2. Finish: Gray, baked enamel.
  3. Identification: "SPARE FUSES" in 1-1/2-inch-high letters on exterior of door.

4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
  1. Service Entrance: Class L, time delay or Class J, time delay.
  2. Feeders: Class L, time delay or Class J, time delay.
  3. Motor Branch Circuits: Class RK5, time delay.
  4. Large Motor Branch (601-4000 A): Class L, time delay.
  5. Power Electronics Circuits: [Class J, high speed.
  6. Other Branch Circuits Class J, time delay.
  7. Control Transformer Circuits: Class CC, time delay, control transformer duty.
  8. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

#### 3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Construction Manager.

#### 3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

## SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

### 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.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Fusible switches.
  - 2. Nonfusible switches.
  - 3. Molded-case circuit breakers (MCCBs).
  - 4. Molded-case switches.
  - 5. Enclosures.

#### 1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
  - 1. Enclosure types and details.
  - 2. Current and voltage ratings.
  - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
  - 4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
  - 5. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.
- B. Shop Drawings: For enclosed switches and circuit breakers.
  - 1. Include plans, elevations, sections, details, and attachments to other work.
  - 2. Include wiring diagrams for power, signal, and control wiring.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
    - b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

## 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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
  - 2. Fuse Pullers: Two for each size and type.

## 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F .
  - 2. Altitude: Not exceeding 6600 feet.

## 1.9 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: One year from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- C. Comply with NFPA 70.

## 2.2 FUSIBLE SWITCHES

- 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. Eaton.
  - 2. General Electric Company.
  - 3. Siemens Industry, Inc., Energy Management Division.
  - 4. Square D; by Schneider Electric.
- B. Type HD, Heavy Duty:
  - 1. Single or Double throw.
  - 2. Three pole.
  - 3. 240 or 600-V ac.
  - 4. 1200 A and smaller.
  - 5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate fuses.
  - 6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
  - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  - 3. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120-V ac.
  - 4. Lugs: Mechanical type, suitable for number, size, and conductor material.
  - 5. Service-Rated Switches: Labeled for use as service equipment.

## 2.3 NONFUSIBLE SWITCHES

- 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. Eaton.
  - 2. General Electric Company.
  - 3. Siemens Industry, Inc., Energy Management Division.
  - 4. Square D; by Schneider Electric.
- B. Type HD, Heavy Duty, Three Pole, Single Throw, 240 and 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

- C. Type HD, Heavy Duty, Three Pole, Double Throw, 240 and 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Accessories:
  - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  - 3. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120-V ac.
  - 4. Lugs: Mechanical type, suitable for number, size, and conductor material.
  - 5. Service-Rated Switches: Labeled for use as service equipment.

## 2.4 MOLDED-CASE CIRCUIT BREAKERS

- 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. Eaton.
  - 2. General Electric Company.
  - 3. Siemens Industry, Inc., Energy Management Division.
  - 4. Square D; by Schneider Electric.
- B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
- C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.
- D. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. MCCBs shall be equipped with a device for locking in the isolated position.
- E. Lugs shall be suitable for 60 deg C rated wire on 125-A circuit breakers and below. 75 deg C and 90 deg C rated wire for breakers larger than 125 A.
- F. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.
- G. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- H. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

- I. Electronic Trip Circuit Breakers 400 A and larger: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
  - 1. Instantaneous trip.
  - 2. Long- and short-time pickup levels.
  - 3. Long- and short-time time adjustments.
  - 4. Ground-fault pickup level, time delay, and I-squared t response.
- J. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- K. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- L. Features and Accessories:
  - 1. Standard frame sizes, trip ratings, and number of poles.
  - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
  - 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
  - 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
  - 5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
  - 6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
  - 7. 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.
  - 8. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.
  - 9. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
  - 10. Accessory Control Power Voltage: Integrally mounted, self-powered.

## 2.5 MOLDED-CASE SWITCHES

- 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. Eaton.
  - 2. General Electric Company.
  - 3. Siemens Industry, Inc., Energy Management Division.
  - 4. Square D; by Schneider Electric.
- B. Description: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
- C. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.
- D. Features and Accessories:
  - 1. Standard frame sizes and number of poles.

2. Lugs:
  - a. Mechanical type, suitable for number, size, trip ratings, and conductor material.
  - b. Lugs shall be suitable for 60 deg C rated wire on 125-A circuit breakers and below. 75 deg C and 90 deg C rated wire greater than 125 A.
3. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
4. Alarm Switch: One NO contact that operates only when switch has tripped.
5. Key Interlock Kit: Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.
6. Zone-Selective Interlocking: Integral with ground-fault shunt trip unit; for interlocking ground-fault protection function.
7. Accessory Control Power Voltage: Integrally mounted, self-powered.

## 2.6 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1), gray baked enamel paint, electrodeposited on cleaned, phosphatized galvanized steel (NEMA 250 Types 3R, 12), brush finish on Type 304 stainless steel (NEMA 250 Type 4-4X stainless steel).
- C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.
- D. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.
- E. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.
- F. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.



## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

### 3.2 PREPARATION

- A. 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 Owner no fewer than seven 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 without Owner's written permission.
  - 4. Comply with NFPA 70E.

### 3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
  - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
  - 2. Outdoor Locations: NEMA 250, Type 3R.
  - 3. Kitchen, Wash-Down, and outside corrosive environment Areas: NEMA 250, Type 4X, stainless steel.
  - 4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

### 3.4 INSTALLATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.

- E. Comply with NFPA 70 and NECA 1.

### 3.5 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

### 3.6 FIELD QUALITY CONTROL

- A. Tests and Inspections for Switches:
  - 1. Visual and Mechanical Inspection:
    - a. Inspect physical and mechanical condition.
    - b. Inspect anchorage, alignment, grounding, and clearances.
    - c. Verify that the unit is clean.
    - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
    - e. Verify that fuse sizes and types match the Specifications and Drawings.
    - f. Verify that each fuse has adequate mechanical support and contact integrity.
    - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
      - 1) Use a low-resistance ohmmeter.
        - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
      - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
        - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
    - h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
    - i. Verify correct phase barrier installation.
    - j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
  - 2. Electrical Tests:
    - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
    - b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
    - c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of

- insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
- d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
  - e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."
- B. Tests and Inspections for Molded Case Circuit Breakers:
- 1. Visual and Mechanical Inspection:
    - a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
    - b. Inspect physical and mechanical condition.
    - c. Inspect anchorage, alignment, grounding, and clearances.
    - d. Verify that the unit is clean.
    - e. Operate the circuit breaker to ensure smooth operation.
    - f. Inspect bolted electrical connections for high resistance using one of the two following methods:
      - 1) Use a low-resistance ohmmeter.
        - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
      - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
        - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
    - g. Inspect operating mechanism, contacts, and chutes in unsealed units.
    - h. Perform adjustments for final protective device settings in accordance with the coordination study.
  - 2. Electrical Tests:
    - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
    - b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
    - c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
    - d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.

- e. Determine the following by primary current injection:
    - 1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    - 2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    - 3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    - 4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.
  3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  4. 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 enclosed switch and circuit breaker. 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 enclosed switch and circuit breaker 11 months after date of Substantial Completion.
    - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.
1. Test procedures used.
  2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
  3. List deficiencies detected, remedial action taken, and observations after remedial action.
- 3.7 ADJUSTING
- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
  - B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."

END OF SECTION 262816

## SECTION 264113 - 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 system for ordinary structures.
- B. Section includes lightning protection system for the following:
  - 1. Ordinary structures.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Include layouts of the lightning protection system, with details of the components to be used in the installation.
  - 2. Include raceway locations needed for the installation of conductors.
  - 3. Details of air terminals, ground rods, ground rings, conductor supports, splices, and terminations, including concealment requirements.
  - 4. Include roof attachment details, coordinated with roof installation.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For lightning protection system to include in maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Dimensioned site plan showing dimensioned route of the ground loop conductor and the ground rod locations. Comply with requirements of Section 017839 "Project Record Documents."
    - b. A system testing and inspection record, listing the results of inspections and ground resistance tests, as recommended by NFPA 780, Annex D.
- B. Completion Certificate:
  - 1. UL Master Label Certificate.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: LPI Master Installer.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- 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. Advanced Lightning Technology, Ltd.
  2. Harger Lightning & Grounding.
  3. Heary Bros. Lightning Protection Co. Inc.
  4. Robbins Lightning, Inc.
  5. Thompson Lightning Protection, Inc.

### 2.2 PERFORMANCE REQUIREMENTS

- A. NFPA Lightning Protection Standard: Comply with NFPA 780 requirements for Class I buildings.
- B. Lightning Protection Components, Devices, and Accessories: Listed and labeled by a qualified testing agency as complying with UL 96, and marked for intended location and application.

### 2.3 MATERIALS

- A. Air Terminals:
  1. Aluminum unless otherwise indicated.
  2. 1/2-inch diameter by 12 inches long.
  3. Rounded tip.
  4. Threaded base support.
- B. Class 1 Main Conductors:
  1. Stranded Copper: 57,400 circular mils in diameter.
- C. Secondary Conductors:
  1. Stranded Copper: 26,240 circular mils in diameter.
- D. Ground Loop Conductor: Stranded copper.
- E. Ground Rods:
  1. Material: Copper-clad steel.
  2. Diameter: 3/4 inch.
  3. Rods shall be not less than 120 inches long.
  4. Sectional type, with integral threads.

- F. Conductor Splices and Connectors: Compression fittings that are installed with hydraulically operated tools, or exothermic welds, approved for use with the class type.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install lightning protection components and systems according to NFPA 780.
- B. Install conductors with direct paths from air terminals to ground connections. Avoid bends less than 90 degrees and 8 inches in radius and narrow loops.
- C. Conceal conductors within normal view from exterior locations at grade within 200 feet of building. Comply with requirements for concealed systems in NFPA 780.
  - 1. Roof penetrations required for down conductors and connections to structural-steel framework shall be made using listed through-roof fitting and connector assemblies with solid rods and appropriate roof flashings. Use materials approved by the roofing manufacturer for the purpose. Conform to the methods and materials required at roofing penetrations of the lightning protection components to ensure compatibility with the roofing specifications and warranty.
  - 2. Install conduit where necessary to comply with conductor concealment requirements.
  - 3. Air Terminals on Single-Ply Membrane Roofing: Comply with adhesive manufacturer's written instructions.
- D. Ground Ring Electrode: The conductor shall be not less than the main-size lightning conductor.

#### 3.2 CONNECTIONS

- A. Aboveground concealed connections, and connections in earth or concrete, shall be done by exothermic welds or by high-compression fittings listed for the purpose.
- B. Aboveground exposed connections shall be done using the following types of connectors, listed and labeled for the purpose: exothermic weld.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

#### 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 would cause deterioration or corrosion of conductors.

#### 3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
  - 1. Perform inspections as required to obtain a UL Master Label for system.
- B. Prepare test and inspection reports and certificates.

END OF SECTION 264113



## SECTION 27 05 26 - TELECOMMUNICATIONS GROUNDING & BONDING

### PART 1 - GENERAL

#### 1.1 PROJECT SCOPE SUMMARY

- A. Passenger loading bridge replacement.

#### 1.2 SECTION INCLUDES

- A. Grounding electrodes and conductors.
- B. Equipment grounding conductors.
- C. Bonding.
- D. Communication system grounding.
- E. Electrical equipment and raceway grounding and bonding.
- F. Control equipment grounding.

#### 1.3 REFERENCES

- A. Related Specification Sections
  - 1. Section 27 05 53 Identification and Labeling of Communication Infrastructure
  - 2. Section 27 15 00 Horizontal Media Infrastructure
  - 3. Section 27 05 43 External Communication Pathways
- B. American Society for Testing and Materials (ASTM):
  - 1. B 3 Soft or Annealed Copper Wires
  - 2. B 8 Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, Soft
  - 3. B 33 Tinned Soft or Annealed Copper Wire for Electrical Purposes
- C. Institute of Electrical and Electronics Engineers (IEEE):
  - 1. 142-82 Recommended Practice for Grounding of Industrial and Commercial Power Systems
  - 2. 383-2.5 IEEE Standard for Type Test of Class IE Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations.
  - 3. 1100 IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment in Industrial and Commercial Power Systems.
- D. Underwriters' Laboratories (UL):
  - 1. 83 Thermoplastic Insulated Wire and Cables
  - 2. 96 Lightning Protection Components
  - 3. 96A System Installation
  - 4. 467 Grounding and Bonding Equipment
- E. National Fire Protection Association (NFPA):
  - 1. 780 Lightning Protection Code
  - 2. 70 National Electrical Code (NEC)

a. NEC Article No. 250 - Grounding

- F. American National Standards Institute/Telecommunications Industry Association/Electronic Industries Alliance (ANSI/TIA/EIA):
  - 1. J-STD-607-B Commercial Building Grounding and Bonding Requirements.
  - 2. Telcordia – Network Equipment Building Systems (NEBS) GR-1275.
- G. Building Industry Consulting Services International (BICSI):
  - 1. Telecommunications Distribution Methods Manual (Latest Issue)
  - 2. Customer Owned Outside Plant Design Manual (Latest Issue)
  - 3. NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
- H. Local, county, state and federal regulations and codes in effect as of date of “notice to proceed” shall be complied with.
- I. Equipment of foreign manufacture must meet U.S. codes and standards. It shall be indicated in the proposal the components which may be of foreign manufacture, if any, and the country of origin.
- J. Reference attached Figure 1 for general grounding infrastructure layout and connectivity.
- K. Conflicts:
  - 1. Between referenced requirements: Comply with the one establishing the more stringent requirements.
  - 2. Between reference requirements and contract documents: Comply with the one establishing the more stringent requirements.

1.4 DESIGN REQUIREMENTS

- A. Design grounding system following ANSI J-STD 607-B – Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications, BICSI Telecommunications Distribution Methods Manual, NECA/BICSI 607-2011, NEC Article No. 250 - Grounding, IEEE 1100 – Recommended Practices for Powering and Grounding Sensitive Electronic Equipment, and IEEE 142-82 - Recommended Practice for Grounding of Industrial and Commercial Power Systems, by a firm acceptable to Owner's insurance underwriter. All labeling shall follow standards set forth by ANSI/TIA/EIA-606 and Houston Airport System's Information Technology (HAS-IT) requirements.
- B. Design Standards:
  - 1. Completely protect above-surface structures and equipment.
  - 2. Calculate system on the basis of existing soil resistivity.
  - 3. If cathodic protection for underground sewer pipe is installed (see applicable Division 2 Sections), ensure the pipe is not connected to the general grounding system, either directly through grounding cable or indirectly through grounded electrical devices connected to the pipe. Electrically isolate electrical devices from sewer pipe.
- C. Radio Equipment
  - 1. All Radio equipment/systems shall be grounded per Motorola Standard R56.

## 1.5 SUBMITTALS

- A. Follow Section 01340 for the following:
- B. Product Data:
  - 1. Manufacturers catalog data and applicable special fabrication and installation details.
  - 2. Installation, terminating and splicing procedures.
  - 3. Instructions for handling and storage.
  - 4. Dimensions and weights.
  - 5. Conformance Certificate and Quality Assurance Release: Signed by QAP Manager (Section 01450). Specifically identify products and include purchase order number, supplements, and item number where applicable. Indicate that requirements are met and identify approved deviations.
  - 6. Include spares list to be approved by HAS IT Project Manager for approval.

## 1.6 QUALITY ASSURANCE

- A. Furnish products of latest proven design, new and in current production. Do not use obsolete components or out-of-production products.
- B. Tests for Insulated Cable: Pass vertical tray flame test following IEEE 383-2.5.
- C. HAS retains the right to inspect all work during the entire duration of the project and any items that do not adhere to the reference, contract, bid, or project documents will be corrected immediately at the expense of the contractor.

## 1.7 SHIPPING AND HANDLING

- A. Ship on manufacturer's standard reel sizes of one continuous length. Where cut lengths are specified, mark reel quantity accordingly.
- B. Protect wire wood lagging or suitable barrier across the traverse of reels. Provide heat-shrink self-sealing end caps on cable.
- C. Equipment shall be delivered in original packages with labels intact and identification clearly marked. Equipment and components shall be protected from the weather, humidity, temperature variations, dirt, dust, or other containments. Equipment damaged prior to system acceptance shall be replaced at no cost to the HAS.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Cable Manufacturers/Suppliers:
  - 1. Houston Wire and Cable Company
  - 2. Okonite Company
  - 3. Anixter

4. Graybar
  5. CSC (Communication Supply Company)
  6. Cablec Continental Cables Company
  7. Pirelli Cable Corporation
  8. Triangle Wire and Cable, Inc.
- B. Ground Rod and Connector Manufacturers:
1. Copperweld
  2. Thomas & Betts
  3. Blackburn
- C. Exothermic Connector Manufacturers:
1. Erico Products (Cadweld)
  2. Burndy Corporation (Therm-O-Weld)
  3. OZ Gedney
- D. Grounding Connector Manufacturers:
1. Thomas & Betts
  2. Burndy Corporation
  3. O.Z. Gedney
  4. Panduit
- E. Telecommunications Busbars:
1. Erico Products
  2. Cooper B-Line
  3. CPI Chatsworth
  4. Panduit
- 2.2 MATERIALS
- A. Grounding Conductors: Bare or insulated copper AWG wire following ASTM-B3, ASTM-B8 and ASTM-B33, of following sizes:
1. A minimum of 6 AWG, stranded, insulated (green) copper conductor shall be used for communications since this accommodates different code requirements and allows for future changes.
  2. Metallic cable shield shall NOT be used as a Telecommunication Bonding Backbone (TBB).
  3. Interior water piping system shall NOT be used as a TBB
- B. Grounding Connectors: It is recommended that connectors should be one of the following:
1. Tin-plated copper.
  2. Copper.
  3. Copper alloy.
- C. Ground Rods: A minimum of 10 feet long, 3/4-inch diameter, copper-clad steel.
- D. Where single conductor insulated grounding conductors is required, furnish green color (or tape marking) insulation rated for 600 volts.
- E. Telecommunications Main Grounding Busbar (TMGB):
1. The TMGB shall be a predrilled copper busbar with standard NEMA

- bolt hole sizing and spacing for the type of connectors to be used. (Both holes in two holed lugs must be attached to busbar)
2. The TMGB shall be sized for the immediate requirements and allow for 100% growth.
  3. The minimum busbar dimensions are .25" thick x 4" wide x 20" long.
  4. The busbar shall be electrotin plated for reduced contact resistance.
- F. Telecommunications Grounding Busbar (TGB):
1. The TGB shall be a predrilled copper busbar with standard NEMA bolt hole sizing and spacing for the type of connectors to be used. (Both holes in two holed lugs must be attached to busbar)
  2. The TGB shall be sized for the immediate requirements and allow for 100% growth.
  3. The minimum busbar dimensions are .25" thick x 2" wide x 12" long.
  4. The busbar shall be electrotin plated for reduced contact resistance.
- G. Rack-Mounted Grounding Busbar (RMGB):
1. The RMGB shall be a predrilled copper busbar with standard NEMA bolt hole sizing and spacing for the type of connectors to be used. (Both holes in two holed lugs must be attached to busbar)
  2. The TGB shall be sized for the immediate requirements and allow for 100% growth.
  3. The minimum busbar dimensions are 3/16" thick x 19" wide x 3/4" long.
  4. The busbar shall be electrotin plated for reduced contact resistance.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Complete site preparation and soil compaction before trenching and driving ground rods for underground use.
- B. Verify exact location of stub-up points for grounding of equipment, fences and building or steel structures.
- C. Verify wiring for lighting systems is single conductor cable in conduit and each conduit contains a green-color insulated equipment-grounding conductor connected to lighting system. If no ground conductor is present, install conductors as required.
- D. Copper and copper alloy connections shall be cleaned prior to connection.
- E. In new construction, the electrical contractor must provide accessible means to a direct electrical service ground, which is one of the best points for grounding communications systems. NEC Section 250.94 and 800.100 requires an intersystem bonding connection accessible at the electrical service equipment, such as:
  1. Approved external connection on the power service panel. The NEC allows direct connection to a provided minimum 6 AWG copper conductor. See Chart 1
  2. Exposed metallic service raceway (using an approved bonding connector).

3. Grounding electrode conductor.
4. For connectivity between buildings and rooms, all bonding conductors are to be placed in conduit end to end and conduit shall be properly grounded. 3/0 conductor to be placed in 2 inch conduit and minimum 6 AWG to be placed in a 1 inch conduit run.

TBB Conductor Size vs. Length	
TBB/GE Linear Length	TBB/GE Size
Feet (m)	(AWG)
Less than 13' (4 -6)	6
14–20' (4 -6)	4
21–26' (6–8)	3
27–33' (8–10)	2
34–41' (10–13)	1
42–52' (13–16)	1/0
53–66' (16–20)	2/0
37–84' (20–26)	3/0
85–105' (26–32)	4/0
*Reference ANSI-J-STD-607-B for more information.	

Chart 1

### 3.2 INSTALLATION

- A. Install work following drawings, manufacturer’s instructions and approved submittal data.
- B. Bonding conductors shall be routed with minimum bends or changes in direction and shall be made directly to the points being bonded, and shall be one continuous run NO splices.
- C. Bonding connections shall be made by using:
  1. Double crimp connectors only for all horizontal runs (cabinets trays etc.). Use listed hardware that has been laboratory tested. For double crimp connectors use 2 hole type connector.
  2. Exothermic welding (per NEC) within the ground electrode system, for parts of a grounding system that are subject to corrosion or that must carry high currents reliably, or for locations that require minimum maintenance. Exothermic-weld to be used on the Telecommunications Bonding Backbone (TBB) conductor for all connections.
- D. Install main ground loop minimum 18” (inches) below ground surface.
- E. Drive grounding rods vertically, so at least 8 feet of rod is in contact with the soil. All connections shall be exothermic-weld. Install additional ground rods as required to pass resistance test.

- F. Make connections only to dry surfaces with paint, rust, oxidation, scales, grease, dirt or other foreign material is removed. Ensure proper conductivity.
- G. Make above-grade grounding connections with Exothermic-weld.
  - 1. Ground small groups of isolated equipment with No. 3/0 minimum insulated conductor connected to the main loop.
- H. Equipment Grounding:
  - 1. Make grounding connections to electrical equipment, vessels, mechanical equipment, equipment enclosure, relay racks, and ground rods in accordance with NEC.
  - 2. Make grounding connections to tanks and vessels to integral structural supports or to existing grounding lugs or pads, and not to the body of the tank or vessel.
- I. Telecommunications Raceway and Support Systems Grounding:
  - 1. Bond and ground raceway, cable rack or tray and conduit together and permanently ground to the equipment grounding busbar. Connection to conduit may be with grounding bushing.
  - 2. Connect ladder-type cable tray to grounding electrode system. Telecommunications cable tray that is located in the same room, as the TGB shall be connected to the TMGB.
  - 3. Bond and ground raceway at low voltage motor control centers or other low voltage control equipment, except conduit which is effectively grounded to sheet metal enclosure by bonding bushing or hubs need not be otherwise bonded.
  - 4. Where only grounding conductor is installed in a metal conduit, bond both ends of conduit to grounding conductors.
  - 5. Provide flexible "jumpers" around raceway expansion joints and across cable tray joints parted to allow for expansion and hinged cable tray connections. Provide copper bonding straps for steel conduit.
- J. Telecommunications Grounding and Bonding Infrastructure:
  - 1. Install the TMGB in the Telecommunications Entrance Facility (TEF) or Main Distribution Frame (MDF) as close to the panel-board as possible. The TMGB shall also be located so that the bonding conductor is as short and straight as possible. Maintain clearances required by applicable electrical codes.
  - 2. If a panel-board is not installed in the TEF or MDF, locate the TMGB near the backbone cabling and terminations.
  - 3. The TMGB shall be insulated from its support with a recommended separation of 2 inches.
  - 4. Connect the TMGB to the electrical service ground and telecommunications primary protectors.
  - 5. The minimum Telecommunications Bonding Backbone (TBB) conductor size shall be No. 2 AWG. The TBB originates at the TMGB and extends throughout the building using the telecommunications backbone pathways, and connects to the TGB(s) in all telecommunication closets and equipment rooms.
  - 6. Install the TGBs in the telecommunications closets and equipment rooms as close to the panel-board as possible. The TGB shall also be located so that the bonding conductor is as short and straight as possible. Maintain clearances required by applicable electrical codes.
  - 7. The TGB shall be insulated from its support with a recommended separation of 2 inches.
  - 8. Properly bond and ground all communications cabinets, equipment racks,

- raceway, cable rack or tray, and conduit directly to TMGB or TGB. Daisy chaining of equipment is not permitted
9. Refer to the Telecom Grounding diagram in the design documentation (see figure 1).
  10. Preparation: Copper and copper alloy connections shall be cleaned prior to connecting.
  11. Bonding conductors shall be routed with minimum bends or changes in direction and shall be made directly to the point being bonded. Change of direction shall be taken over as wide a radius as possible with a minimum radius of one foot.
  12. Make connections only to dry surfaces with paint, rust, oxides, scales, grease and dirt removed. Ensure proper conductivity.
  13. Grounding conductors, by gauge, shall be continuous, with splices, from a larger gauge feeder to the last frame or component served by the grounding lead (ex. 750 KCM to 500 KCM to 1/0, etc.).
  14. C-Taps from Aisle equalizer to a frame can be the same gauge (ex. E.g., 6 AWG to 6 AWG).
  15. Cable to Cable taps shall be made with exothermic weld, or listed compression connectors.
  16. No aluminum conductors or connectors shall be used in any bonding and grounding system.
  17. Ground bars not supplied as part of a standard assembly shall be copper or tinned copper.
  18. Refer Telecommunications Grounding drawings for additional information.
  19. Both ends of the grounding conductors shall be equipped with a printed destination label recording the far end termination. The label shall be applied within 6 inches of the termination and be visible from the floor.
  20. All metallic items that interact electro-magnetically with Network/Telecommunications equipment shall have their framework bonded and grounded to the Telecommunications grounding system with a minimum #6 AWG grounding conductor. Example includes switch frames, power plants frames, battery stands, storage cabinets and other metallic objects, etc. "Daisy Chaining" or frame to frame connecting of these conductors is NOT permitted.
  21. TMGB and TGB shall be stenciled and labeled per HAS requirements.
- K. Fences and Gates in the equipment rooms:
1. Ground fences, fence posts and gates to nearest TMGB or TGB.
- L. Telecommunications Cable Armored and/or Shielded:
1. Terminate and ground shield of shielded control cable at one end only, preferably at the control panel end for instrument and communication cable and at the supply end for electronic power cables. Maintain shield continuity by jumpering the ground shield across connection point where it is broken at junction boxes or other splice points.
  2. Connect ground wire in power cable assemblies at each terminal point to a ground bus, if available, or to the equipment enclosure. Do not extend these ground wires through "doughnut" CTs used for ground fault relaying, but do extend ground leads from stress cones. Ground power cable armor and shield at each terminal point.
  3. Bond and ground exposed cable shields and metallic sheaths according to the manufacturer's guidelines. They shall also be grounded as close as possible to the point of entrance.

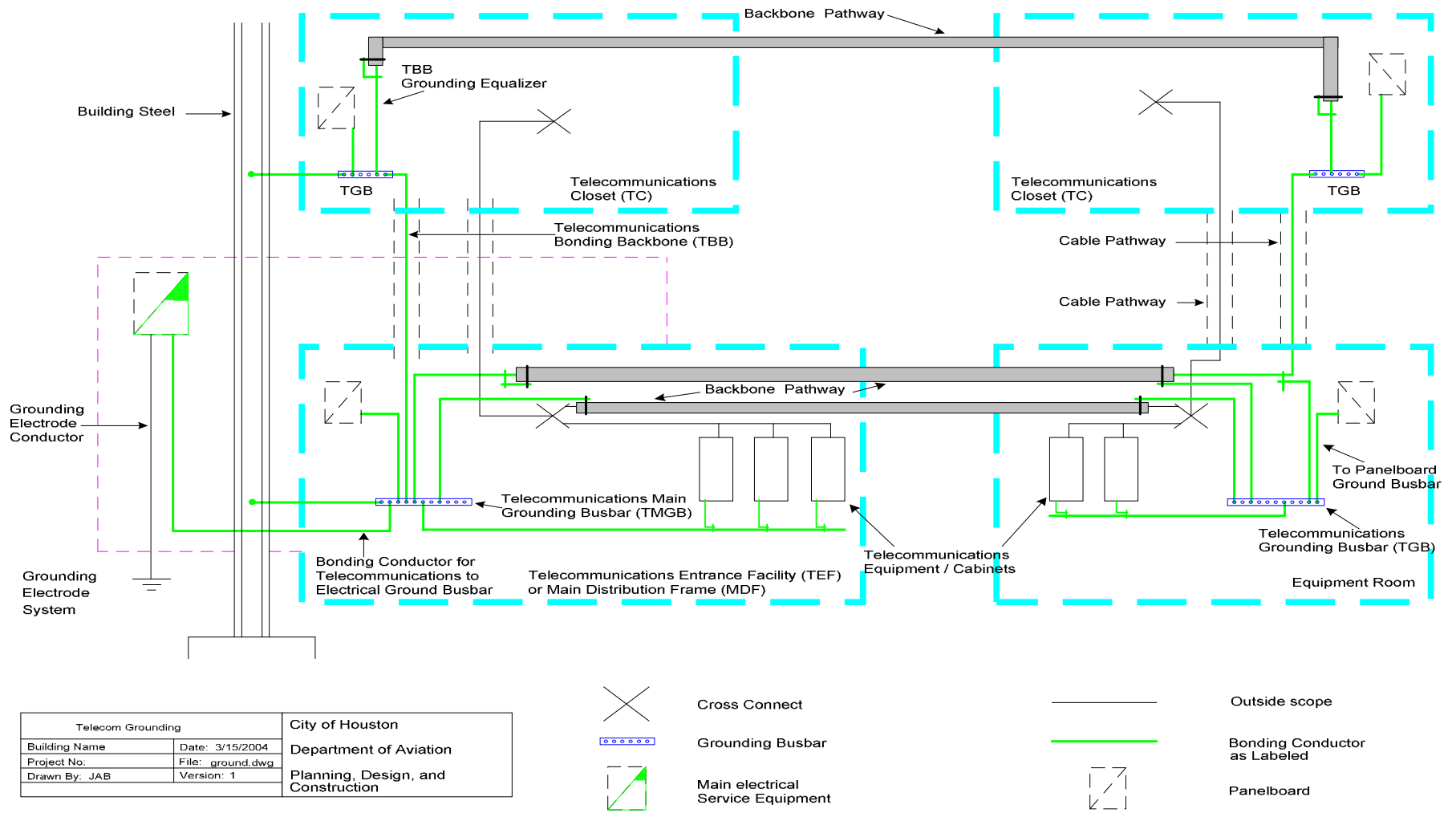


4. Intra-building telecommunications cabling that is armored or has a metallic shield must be bonded to the building grounding system at each end.

### 3.3 TESTING

- A. Follow Section 01450.
- B. Test grounding system before grid trenches are back-filled. Test for ground resistance after installation of underground grid and grounding connections.
- C. Install ground access test wells at locations as required for testing, using a pipe surrounding the rod and connections with a cover placed on top at grade level.
- D. Test system resistance at each test well using "Fall of Potential" method Per IEEE Standard No. 81-1983) with a maximum resistance of 5 ohms.
- E. Upon completion of the electrical system, including all grounding, the Electrical Contractor shall test the system for stray currents, ground shorts, etc. Approved instruments, apparatus, service, and qualified personnel shall be utilized. If stray currents, shorts, etc., are detected, eliminate or correct as required. The test procedure shall be as follows:
  1. Open all main disconnects for the system being tested.
  2. Disconnect the system neutral from the service entrance or step-down transformer neutral connection.
  3. Connect a DC ohmmeter across the system neutral and equipment ground.
  4. An ohmmeter reading in excess of 100 ohms shall indicate that the system neutral and equipment ground are properly isolated.
  5. An ohmmeter reading less than 100 ohms shall indicate that the system contains ground shorts (stray currents) at some point along the system neutral.
  6. Grounded neutrals may be identified by disconnecting individual neutral conductors from the system, one at a time, while monitoring the ohmmeter.
  7. The systems shall be re-tested after correction of all ground shorts is complete.

END OF SECTION – 27 05 26



Telecom Grounding		City of Houston
Building Name	Date: 3/15/2004	Department of Aviation
Project No:	File: ground.dwg	Planning, Design, and Construction
Drawn By: JAB	Version: 1	

Figure 1

## SECTION 27 05 43 - EXTERIOR COMMUNICATION PATHWAY

### PART 1 - GENERAL

#### 1.1 PROJECT SCOPE SUMMARY

- A. Passenger loading bridge replacement.

#### 1.2 SECTIONS INCLUDES

- A. This section includes specifications for the installation of exterior communications pathways.
- B. Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division - 1 Specification sections, apply to the work of this section.
- C. Exterior Communication Pathways are defined to include, but are not limited to innerduct, flexible multi-cell innerduct, conduit, manholes, handholes, concrete encased ductbanks racking material, manhole and handhole lids.

#### 1.3 REFERENCES

- A. Related Sections: Use these Specifications for all related work not specifically covered in this specification.
  - 1. Section 27 05 26: Telecommunication Grounding and Bonding
  - 2. Section 27 05 53: Identification and Labeling of Communication Infrastructure
  - 3. Section 27 15 00: Horizontal Media Infrastructure
- B. Building Industry Consulting Services International (BICSI):
  - 1. Telecommunications Distribution Methods Manual (Latest Issue)
  - 2. Customer Owned Outside Plant Design Manual (Latest Issue)
- C. HS20 (AASHTO) highway Fatigue Loading
- D. American National Standards Institute/Telecommunications Industry Association/Electronic Industries Association (ANSI/TIA/EIA):
  - 1. 569 Commercial Building Standard for Telecommunications Pathways and Spaces
  - 2. 758 Customer-Owned Outside Plant Telecommunications Cabling Standard
- E. Conflicts:
  - 1. Between referenced requirements: Comply with the one establishing the more stringent requirements.
  - 2. Between reference requirements and contract documents: Comply with the one establishing the more stringent requirements.

#### 1.4 SUBMITTALS

- A. Submit plan and section drawings detailing proposed communication pathway routing prior to installation. Communication pathway installation plan to include but not limited:
  - 1. Room penetration plan.
  - 2. Communication pathway extension plan.

3. Conduit chase plan.
  4. Duct bank pathway
  5. Handhole/Manhole Details
  6. Handhole/Manhole Lids
- B. Shop Drawings shall be submitted and approved before implementation is started. Shop Drawings shall be submitted in accordance with Specification 01340.
- C. Submit calculations associated with sizing and arrangements of ducts and cables.
- D. Manufacturers' data: To include but not limited to part numbers, data sheets and detailed descriptions, for ALL proposed equipment and material.
- E. Submit a schematic with the COMM Vault/MH/HH duct bank layout showing the wall-to-wall, center to center and a MH butterfly detail down to individual flexible innerduct and hard innerduct assignments in AutoCAD.
- F. Submit plan and section drawings detailing proposed vault specifications.
- G. Copy of Building Industry Consulting Services International (BICSI) Registered Communication Distribution Designer (RCDD) certificate for Contractor's on-site RCDD supervisor. RCDD shall always supervise all parts of communications installation.

#### 1.5 QUALITY ASSURANCE

- A. Verify duct banks does not interfere with existing or new underground facilities. Follow Section 01761.
- B. Follow Appendix B of National Electrical Code.
- C. Assure that the "as installed" system is correct and complete per construction documents: including engineering drawings, manuals, and operational procedures in such a manner as to support maintenance and future expansion of the system.
- D. Contractor Qualifications:
1. The Contractor shall submit references and other related evidence of installation experience for a period of three years prior to the issue date of this Specification.
  2. ALL work shall be supervised on-site by a BICSI RCDD. Must demonstrate knowledge and compliance with all BICSI, TIA/EIA, UL, and NEC standards and codes.
- E. HAS retains the right to access and inspect all work during the entire duration of the project and any items that do not adhere to the standards, reference, contract, bid, or project documents will be corrected immediately at the expense of the contractor.
- F. Prior to cable installation HAS IT shall be contact to conduct a pathway inspection. No cable shall be installed prior to an approved inspection.

#### 1.6 SHIPPING AND HANDLING

- A. Follow Section 01450.
- B. Clearly mark containers "For Communication Material Only".

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Conduit Measuring Tape:
  - 1. Neptco
  - 2. Greenlee
  - 3. Garvin Industries
- B. Caution Tape:
  - 1. Reef Industries
  - 2. Repnet
  - 3. Panduit
- C. Maintenance/Hand Hole Covers
  - 1. Dabico Inc
  - 2. Ejco
  - 3. Locke Solutions
  - 4. Neehan Foundry
  - 5. Oldcastle
- D. Flexible Multi-cell Innerduct
  - 1. MaxCell
  - 2. Or HAS approved equivalent
- E. Plastic Innerduct: HAS-IT approval required before installation.
  - 1. Carlon
  - 2. Pyramid
  - 3. Or HAS approved equivalent

### 2.02 MATERIALS

- A. Ducts: Schedule 40 rigid PVC following this section, with non-magnetic universal interlocking type spacers for both horizontal and vertical duct arrangements. Duct bank will be encased in concrete with orange color dye.
- B. Duct Spacers and Hardware: On all conduit arrays, the contractor shall furnish and install a conduit spacer system as required to maintain uniform conduit spacing. The system shall consist of plastic spacers that interlock vertically and horizontally. A spacer assembly shall consist of base spacers, intermediate spacers and top spacers to provide a completely enclosed and locked in conduit assembly. Install spacers per manufacturer's instructions and provide at 5-foot intervals.
- C. Plastic conduit and fittings shall conform to the requirements of Fed. Spec. W-C-1094 and shall be rigid PVC Schedule 40, with non-magnetic universal interlocking type spacers for both horizontal and vertical duct arrangements.
- D. Maintenance Hole (MH) shall be a minimum 144" x 72" x 84" and shall be designed as needed.

- E. Hand Hole (HH) shall be minimum 48" x 48" x 48" constructed with a minimum 5-inch-thick concrete (or HAS approved equivalent).
1. HH shall be pre-formed
  2. Include a minimum 12" sump drain
  3. Include stainless steel bonding ribbon and /or 1" knockout for ground stainless steel rod connection.
  4. Fitted with pulling irons at each end.
5. All HH internal components such as racking and ground strips shall be field installable and shall meet the requirements of ANSI/TIA/EIA, NEC, and HAS requirements.
6. All walls shall have a minimum of 2- 3 x 3" saddle Throat openings cable rack supports, yellow in color (3SR3N).
7. All walls shall include 4" duct terminators minimum of 2 wide x 2 height terminators verses a 24" x 24" x 4' thin wall K.O. window on each wall.
- F. HH cover: Shall require a maximum 35-lb lift to open and close
1. Cover and service lettering shall be abrasion, corrosion, chemical resistant and slip resistant surface.
  2. Door shall use a non-load bearing, internally mounted hinge mechanism and shall have a high visibility warning label affixed to the underside
  3. The cover shall be removable from the cover frame assembly with a minimum opening clearance size of 36" x 36" (See attached figure 1 part number 8197)
  4. A prototype test report for each cover style to be installed shall be submitted. The testing shall be conducted by an independent testing company and shall conform to the following:
    - a. Carry a proof load of 29,250 lbs. applied at 150 psi without deformation or injury to the cover
    - b. Carry a maximum HS20 service load, applied at 100 psi for a minimum of 525,000 cycles without losing its service life
    - c. Carry a maximum HS20 service load applied continuously at 100 psi for twelve continuous hours without exhibiting an increase in residual deflection, as measured at the center of the cover, of more than 0.4% (0.004)
    - d. Covers have a modulus of elasticity of, at least, 3,500,000 psi, a flexural strength of 53,000 psi, and a compressive strength of 62,000 psi.
  5. AOA covers to meet or exceed FAA loading standards.
  6. All HH covers shall include the following (see attached figure 1):
    - a. Slip Resistant surface
    - b. Four (4) ½-13 x 2 ¼" Hex bolts with Stainless Steel washers
    - c. "HOUSTON AIRPORT SYSTEM" shall be casted on the lid ½" FLAT FACE GOTHIC. (See attached figure 1).
    - d. "HAS COMMUNICATIONS" shall be casted on lid ¼" FLAT FACE GOTHIC. (See attached figure 1).
    - e. "TELECOM" shall be cast on lid 2" FLAT FACE GOTHIC. (See attached figure 1).
    - f. Submit proof for approval prior to customizing covers.
    - g. Obtain permanent HH number from HAS IT. Field punch or weld MH number at time of installation.
    - h. Submit cross reference table with construction MH number and permanent MH number.
    - i. All cover and hinge hardware shall be stainless steel.
    - j. All covers shall have a Security camlock and MPIC multi-tool pick bar.

- k. Ram-Nek shall be installed in between the handhole, frame and cover.
  - l. All covers shall a self-engaging safety bar and a stainless-steel mechanical spring strut for lift assist. Cover shall open to 105 degrees, safety catch and removal at 90 degrees.
- G. AOA HH will be 48" x 48" x 48" and constructed of 8-inch-thick concrete covered with 250 psi, aircraft rated cover plates containing an approved locking device with a 35-pound lift to open and close.
- 1. All HH covers shall include the follows:
    - a. Slip Resistant surface
    - b. Four (4) 1/2-13 x 2 1/4" Hex bolts with SS washers
    - c. "HOUSTON AIRPORT SYSTEM" shall be casted on the lid 1/2" FLAT FACE GOTHIC. (See attached figure 1).
    - d. "HAS COMMUNICATIONS" shall be casted on lid 1/4" FLAT FACE GOTHIC. (See attached figure 1).
    - e. "TELECOM" shall be cast on lid 2" FLAT FACE GOTHIC. (See attached figure 1).
    - f. Submit proof for approval prior to customizing covers.
    - g. Obtain permanent HH number from HAS IT. Field punch or weld MH number at time of installation.
    - h. Submit cross reference table with construction MH number and permanent MH number.
    - i. All cover and hinge hardware shall be stainless steel.
    - j. All covers shall have a Security camlock and MPIC multi-tool pick bar.
    - k. Ram-Nek shall be installed in between the manhole, frame, and cover.
    - l. All covers shall a self-engaging safety bar and a stainless-steel mechanical spring strut for lift assist. Cover shall open to 105 degrees, safety catch and removal at 90 degrees
- H. Concrete and Reinforcing Steel for Encasement: Furnish products following Section 01610 and Division 3 except strengths as follows:
- 1. Compressive Strength: 2500 psi at 28 days, class A.
  - 2. Flexural Strength: 500 psi at 28 days.
  - 3. Dye concrete encasement "ORANGE" to identify Communication Duct banks.
- I. Flexible Innerduct:
- 1. Flexible innerduct is the HAS standard for multi-path applications within conduit.
  - 2. All backbone fiber shall be installed in flexible innerduct.
  - 3. All backbone copper cable 1 inch and smaller will be installed in flexible innerduct.
  - 4. All flexible innerduct shall be installed per manufacture requirements.
  - 5. Only manufacturer's fittings, transition adapters, terminators, accessories, and installation kits shall be used.
  - 6. All flexible innerduct cells will be populated with a measured pull tape.
  - 7. All flexible innerduct shall be OSP rated.
  - 8. Flexible innerduct shall only be used when installed in conduit

MaxCell 4" 3 Cell

Min Conduit ID	Suggested Product	Max # of Packs	Max # of Cables	Maximum Cable	Rec. Pull Length*	Max Pull Length*
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				Diameter per Cell		
3"	MaxCell 4" 3 Cell	1	3	1.34"	1500'	2000'
4"	MaxCell 4" 3 Cell	2	6	1.34"	1500'	2500"
5"	MaxCell 4" 3 Cell	3	9	1.34"	1500'	2500'
6"	MaxCell 4" 3 Cell	4	12	1.34"	1500'	2500'

\*Use of OFNR cable may result in reduced pulling lengths

MaxCell 3" 3 Cell

Min Conduit ID	Suggested Product	Max # of Packs	Max # of Cables	Maximum Cable Diameter per Cell	Rec. Pull Length*	Max Pull Length*
3"	MaxCell 3" 3 Cell	2	6	1.03"	1200'	2000'
4"	MaxCell 3" 3 Cell	3	9	1.03"	1500'	2500"
5"	MaxCell 3" 3 Cell	4	12	1.03"	1500'	2500'
6"	MaxCell 3" 3 Cell	5	15	1.03"	1500'	2500'

\*Use of OFNR cable may result in reduced pulling lengths

MaxCell 2" 3 Cell

Min Conduit ID	Suggested Product	Max # of Packs	Max # of Cables	Maximum Cable Diameter per Cell	Rec. Pull Length*	Max Pull Length*
2"	MaxCell 2" 3 Cell	1	3	.70"	800'	1500'

\*Use of OFNR cable may result in reduced pulling lengths

- J. All Plastic innerduct must be approved by HAS before installation.

2.03 ACCESSORIES

- A. Continuous Tape for Underground Conduit: orange warning ribbon, PVC tape (detectable, i.e., containing metallic tracings), minimum 5 mils thick and 3 inches wide, permanently imprinted with "CAUTION--BURIED COMMUNICATIONS LINE BELOW" in black letters, minimum 1-inch high.

**PART 3 - EXECUTION**

3.1 PREPARATION

- A. Verify materials are on site in proper condition and of sufficient quantity.
- B. Verify proper excavation depth; verify width route and support of work. (Division 2). Ducts shall be installed so that the tops of all ducts are at least 36 inches below the finished grade. Verify proper location of hand holes and MH (maximum every 600 feet). Communications facilities must be placed in separate MH/HH from electrical facilities.
- C. Trenches greater than or equal to 5 feet deep:
  1. Shall be shored to prevent cave-in.



2. Shall have 2 feet clearance from the dirt pile.
- D. Directional boring (HAS IT prior approval required) is a suitable substitute when trenching is impractical or impossible. Bore logs shall be submitted as deliverables along with the GPS/GIS data information to include but not limited to, depth every 10-12 feet, x and y coordinates. Refer spec section 270553 for the GIS data collocation deliverable. A 6-gauge trace wire shall be installed with the conduit. Locating existing underground utilities is crucial when directional boring is planned because of the potential for the drilling unit to encounter high voltages. Although directional boring machines are manufactured with electrical strike sensing capabilities, which can warn the operator of any contact with a high voltage source, accidents may still occur.
  1. Operators of directional boring machines require special protection due to the potential for exposure to high voltage. Therefore, operators shall always have a ground mat grid underfoot as insulation protection. In addition, operators shall wear insulating boots and gloves, along with hard hats and safety glasses.
  2. Casings shall be installed when boring conduits under streets, roadways, runways and or taxiways.
- E. Minimum electrical/communications underground cable separation:
  1. Concrete: 3 inches
  2. Masonry: 4 inches
  3. Well-tamped earth: 12 inches
  4. Electrical: 12 inches
- F. Before encasement, verify ducts are free of debris and properly installed in support and spacer system, are properly fitted together and hold-down hardware is properly installed.

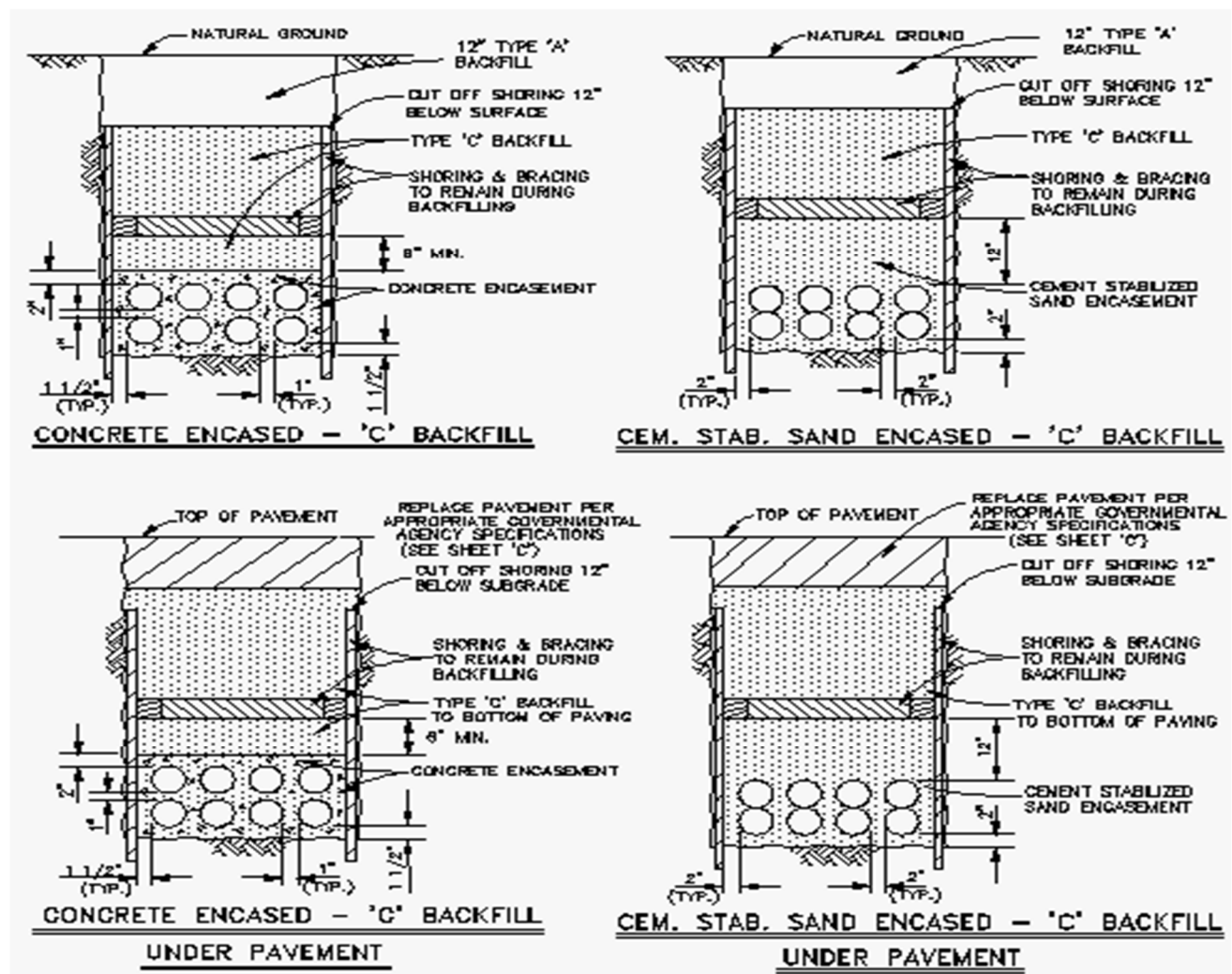
### 3.2 INSTALLATION

- A. Prior to installation, the contractor shall comply with Specification 270553 referencing GIS GPS requirements during the installation of all manholes / handholes and duct banks.
- B. Install all work following drawings, manufacturer's instructions and approved submittal data.
- C. Install conduit in excavations following Drawings. If directional boring is utilized, cable or flexible conduits can be attached to the unit and pulled back to the origination point (after the drilling unit reaches its destination).
- D. HH shall be 48" x 48" x 48" and shall be constructed of two-inch thick concrete covered with 3/8-inch steel plate. The hand hole or MH shall rest on a 4-inch blanket of 2 sack stabilized sand, and 4 inches around the side walls shall be filled with 2 sack stabilized sand. Refer to Division 02.
- E. Each MH/HH that contains a pedestal will have four bollards installed 18 inches diagonally from each corner, with a cross member welded at 30 inches connecting the Four Corners. These barriers will be constructed of 4-inch ridged conduit filled with concrete, driven four feet in the ground and extending 36 inches above the protective cover.

- F. Install watertight penetrations through foundation, HH, and MH walls. Wherever a hand hole is used to simply pass through, the conduit entrances and exits shall be situated at opposite ends of the hand hole instead of 90-degree angles.
- G. Assemble duct banks with non-magnetic saddles, spacers and separators. Position separators for 2-inch minimum concrete separation between outer surfaces of adjacent ducts.
  - 1. Make uniform required bends with a minimum of a 24-inch radius for conduits less than 3-inch diameter, and a 48-inch radius for conduits 3 inches and larger.
  - 2. Maintain vertical or horizontal separations of 12 inches of well-packed topsoil from any electrical service conduit run parallel to Communications conduits.
- H. Install reinforcing. Install concrete encasement surrounding reinforcing steel and ducts. Refer to Division 03 using one-inch maximum size coarse aggregate concrete.
  - 1. Unless otherwise noted on the drawings, reinforce with No. 4 longitudinal steel bars placed at each corner and along each face at maximum parallel spacing of 12 inches o.c., and No. 3 tie-bars transversely placed at 12 inches o.c. maximum longitudinal. Maintain maximum clearance of 2 inches from bars to edge of forms and ducts.
  - 2. Sprinkle ORANGE colorants on top of concrete.
    - a. ORANGE: For Telecommunications.
  - 3. Place concrete with minimum 3-inch cover surrounding ducts and reinforcement.
  - 4. Maintain ducts in proper place during concrete placement.
- I. Transition from non-metallic to PVC coated metallic conduit where duct banks enter structures or turn upward for continuation above grade.
  - 1. With prior HAS/IT APPROVAL. For conduit runs (1" to 4") a special LBD conduit (Crouse-Hinds or approved equal) may be used for exterior wall penetration where a swept 90 will not work. LBD condulets are designed for communications cable installation to maintain bend radius requirements.
- J. Where ducts enter structures such as HH, MH, pull boxes, or buildings, terminate ducts in proper end bells, provide insulated L-bushings and grout walls at the conduit entrance points. Terminators or bells shall be installed at the wall for a flush installation. All ducts shall be sealed with Meyers hubs or couplings on steel conduits ducts and/or sealed with watertight mechanical plugs with a max back Air Pressure 17 PSI, Max Back Pressure 40 ft of Head.
- K. Extend below grade conduits to 4 inches above the finished floor inside a building.
- L. Tag conduits entering pull boxes with stamped stainless-steel tags following cable and conduit schedule.
- M. Install continuous, orange warning ribbon, PVC tape (detectable, i.e., containing metallic tracings), 3 inches wide, permanently imprinted with "CAUTION - BURIED COMMUNICATIONS LINE BELOW" in black letters, approximately 12 inches below finished grade following line of duct banks.
- N. Expansion Fittings:
  - 1. Raceways shall be provided with expansion fitting where necessary to compensate for thermal expansion and contraction.
  - 2. Use expansion-deflection fittings on conduit crossing structural expansion joints and on exposed conduit runs where necessary. Provide bonding jumpers across fittings in metal raceways systems

### 3.3 BACKFILLING

- A. Backfill following Division 02320 after concrete cures 24 hours. After concrete encased ducts have been properly installed, and the concrete has had time to set, the trench shall be backfilled in at least two layers with excavated material, not larger than four inches in diameter, thoroughly tamped, and compacted to at least the density of the surrounding undisturbed soil. If necessary to obtain the desired compaction, the backfill material shall be moistened or aerated as required. Trenches shall not be excessively wet and shall not contain pools of water during backfill operations. The trench shall be completely backfilled and compacted level with the adjacent surface. Any excess excavated material shall be removed and disposed of offsite at the contractor's expense.
- B. Type 'C' Backfill Cement Stabilized Sand  
Two (2) sack stabilized sand is authorized only with HAS IT Infrastructures prior approval. Compact 2 sack stabilized sand in 6" to 8" lifts to a 95% of maximum density as determined in accordance with ASTM D558, ASTM D698 and ASTM D1633, unless otherwise specified in spec section 02321. Perform and complete compaction of 2 sack stabilize cement mixture within 4 hours from the load delivery receipt.



- C. If trench is in a grassy area: sod and pin to match the original condition.

### 3.4 MAINTENANCE HOLES / HANDHOLES

- A. Installation shall be in accordance with the manufacturer's requirements. Top of MH/HH cover shall be set  $\frac{1}{4}$  inch above finished pavement or one inch above finished grade.
- B. MH/HH shall be bedded on four inches of 2 sack stabilized sand with  $\frac{3}{4}$  inch gradation.
- C. Have ducts stubbed into the MH/HH, which shall terminate in end bells cast in concrete flush with the inside walls. Ducts shall enter the MH/HH at the lowest knockout window available.
- D. MH/HH shall be fitted on each wall with cable racks and struts. Each rack shall be provided with a minimum of four rack type arms. Rack arms shall be made of non-flammable polymer.
- E. MH shall be provided with a pulling eye on each end and a drainage sump in the bottom.
- F. HH shall be provided with a pulling eye on each end and a drainage sump in the bottom.
- G. MH/HH shall be provided with a  $\frac{3}{4}$  inch by 10-foot stainless steel ground rod in each MH. See Section 270526 for ground rod specification. Do not install the ground rod through the drain sump. Install through a prepared opening and grout fill after installation.
- H. All vacant ducts shall be sealed with an HAS and Industry approved water-tight and gas-tight mechanical plugs with max back Air Pressure 17 PSI, Max Back Pressure 40 ft of Head.
- I. All flexible innerducts and plastic innerducts shall be sealed with an HAS and Industry approved watertight and gas-tight plugs.
- J. All occupied ducts shall be sealed with Triplex duct plugs, Quadplex duct plugs or HAS and Industry approved water-tight and gas-tight plugs.
- K. Where more than one innerduct is routed in a conduit, each innerduct shall consist of a different color (ex. Orange, Blue, Black and White). HAS-IT approval required before installation.
- L. When populating duct bank with plastic innerduct the following apply: HAS-IT approval required before installation.
  - 1. Innerduct to be OSP rated
  - 2. 4" duct to be populated with no less than 3-1.25 inch innerducts
  - 3. 4" duct to be populated with no less than 4-1 inch innerducts
- M. All fiber cables shall be placed in flexible innerduct and comply with 271300 guidelines.
- N. All copper cables 100 pairs or less shall be placed in flexible innerduct.
- O. A 12-inch-long mandrel shall be swabbed through all ducts to remove debris until shown clean ( $\frac{1}{4}$  inch smaller than duct diameter).

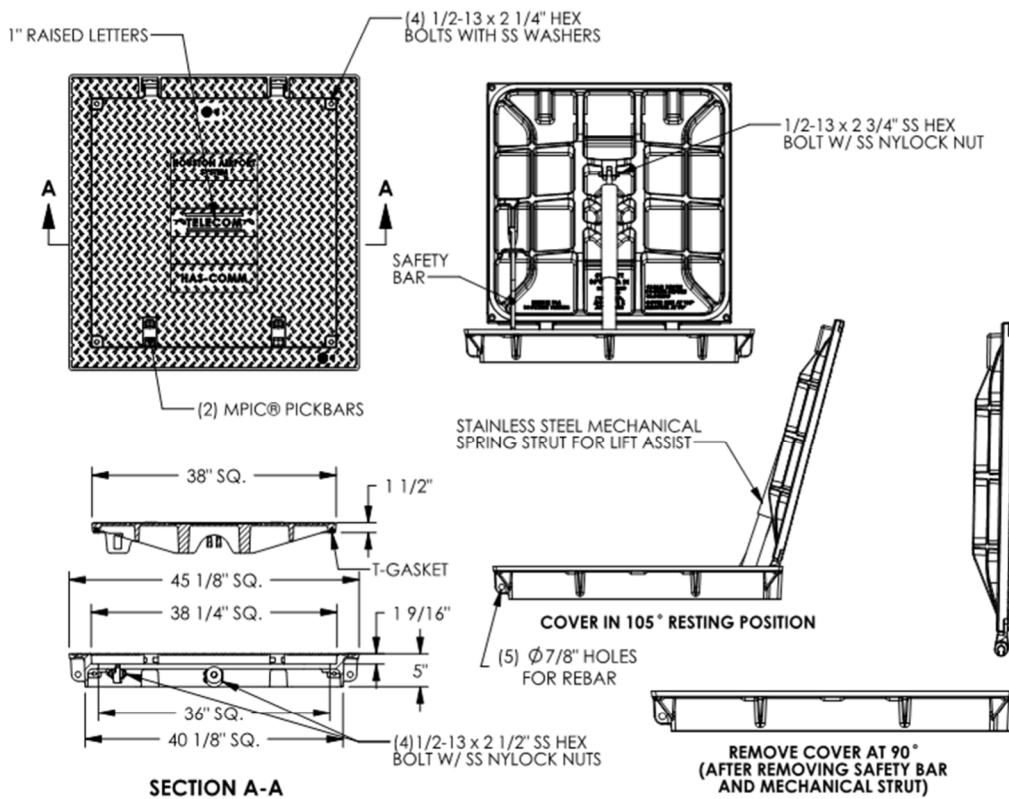
- P. A conduit measuring tape, with a minimum test rating of 1250 pounds of pulling tension shall be installed in all underground conduits, flexible innerducts and plastic innerduct when applicable. Label each end of the duct bank in every MH to ensure continuity per specification 270553.

3.5 IDENTIFIERS, LABELS AND LABELING SYSTEM

- A. All Identification and Labeling shall follow Specification: 270553–Identification and Labeling of Communication Infrastructure. **Any deviation from the specification must be approved by HAS IT prior to installation.**

Figure 1

8197 Assembly



**Product Number**  
00819766B01

**Design Features**

- Materials
  - Hatch Frame Ductile Iron (70-50-05)
  - Hatch Cover Ductile Iron (80-55-06)
- Design Load
  - Airport Extra Heavy Duty (Proof Load Tested to 200,000lbs.)
- Open Area
  - n/a
- Coating
  - Dipped
- √ Designates Machined Surface
- Slip Resistant Surface with the LLLL® registered trademark

**Certification**

- ASTM A536
- 
- Country of Origin: USA

**Major Components**

00819712  
00819766

**Drawing Revision**

12/2/2010 Designer: SMM  
02/06/2012 Revised By: DEF

**Disclaimer**

Weights (lbs/kg), dimensions (inches/mm) and drawings provided for your guidance. We reserve the right to modify specifications without prior notice.

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**Contact**

800.626.4653  
ejco.com



## Ductile Iron Hinged Hatch Access Assembly

Ductile iron access hatches have been designed for improved ergonomics, and are available in heavy duty and airport extra heavy duty applications. On a cover that can weigh as much as 550 lbs, the lifting force required to open the cover is less than 35 lbs due to the uniquely designed mechanical strut. The self-engaging safety bar provides added protection while the underground infrastructure is accessed, and safety grates can be specified for added fall through protection.

### Features

- Ductile iron frame and cover
- Cover opens to 105°, safety catch and removal at 90°
- Self-engaging safety bar
- EONLOCK®
- MPIC® multi-tool pick bar
- Bolting

### Options

- Mechanical lift assist (standard feature for airport rated models)
- Top and bottom flange designs
- Safety grates
- INFRA-RISER® adjustment riser
- Forming skid

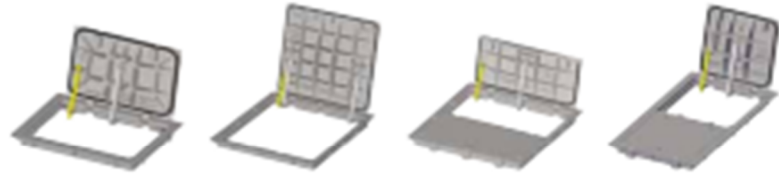


8197 grate option  
36" x 36"



### Wide Availability of Sizes

Shown below are just a sample of the various cover openings and sizes. See the table below for the full range of available clear opening sizes and load ratings.



8192 hinged hatch  
24" x 36"

8198 hinged hatch  
with class III assist  
42" x 40"

8218 double assembly 40"  
x 40"

8196 double assembly 30"  
x 62"

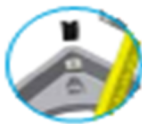
### Ductile Hinged Hatch Clear Opening Options

Clear Opening Size	Airport Extra Heavy Duty Series No.	Heavy Duty Series No.
24 x 24	8195	8215
24 x 36	8192	8212
30 x 30	8196	8216
30 x 62	8196—Double	8216—Double
36 x 36	8197	8217
36 x 74	—	8217—Double
48 x 48	8198	—
48 x 48	—	8218—Double

Note: All dimensions are in inches.

Ductile Iron Winged Hatch Access Assembly

**EON LOCK®**



Cavity and rubber plug raises the nut, which wedges, eliminating the need to drill and tap the flange.

Patented Self-engaging Safety Bar

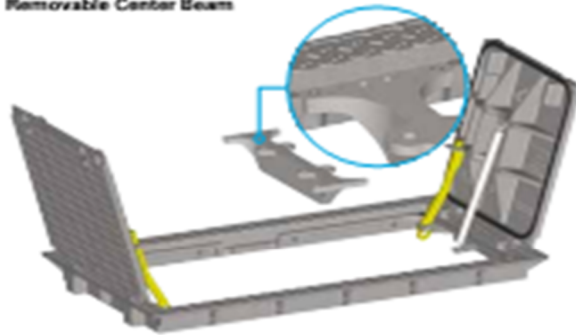


**Optional Safety Grate**

Provides additional safety features:

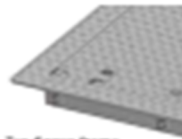
- Doors cannot be closed unless the fall through protection has been put back in place (protecting the next operator).
- Visual inspections and limited maintenance can be done while safety grate is left in place.
- Orange safety grates create a visual barrier around the pit, an orange open coating promotes an awareness of the hazard and provides a durable finish.
- Grates can be locked independently of the hatch, adding another level of security when needed.

**Removable Center Beam**

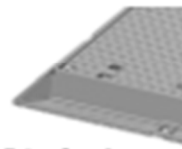


Removable center beam provides a much greater clear opening access on several double hatch models. Removal/replacement is simple with 4 bolts securing the beam to the frame.

**Frame Options**



Top flange frame



Bottom flange frame

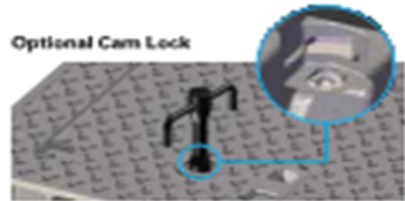
**Lift Assist**

Lift Assist is a corrosion-resistant stainless steel mechanical spring strut. The rugged design is clean and maintenance free. The strut takes up less space in the clear opening than a traditional spring assist. It is fully self-contained, protecting coils from exposure to the elements.

Made without internal gases or seals, the struts have an effective operating temperature range of -36° F to 408° F. The durability has been tested at over 750,000 cycles.



**Optional Cam Lock**



Security cam lock and wrench shown. Wrench is only removable when door is in the locked position.



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END OF SECTION – 27 05 43



## SECTION 27 05 53 – IDENTIFICATION AND LABELING OF COMMUNICATIONS INFRASTRUCTURE

### PART 1 – INTRODUCTION

#### 1.1 GENERAL

- A. As the Houston Airport System (HAS) continues to develop both its private and commercial interests, it is essential that an effective telecommunications infrastructure be developed and maintained to ensure the support of any and all services which rely on the electronic transport of information. To effectively administer these assets requires a disciplined effort that begins with a systematic practice and procedure for capturing useful data regarding inventories that might be conducted at any point during the lifecycle of a project.

#### 1.2 OBJECTIVE

- A. The objective and intent of this standard is to provide uniform GIS inventory and documentation practices/guidelines for any person or party directly involved with data collection, administration and/or accountability of the HAS IT telecommunications infrastructure or related systems.

#### 1.3 INTENDED USE

- A. Any designer, consultant or engineering entity contracting with the Houston Airport System to inventory/document the telecommunications physical and network configurations will need to refer to this document for clarification regarding standard operating procedures. The guidelines given here provide for effective documentation of the HAS telecommunications network. The result of following this standard will be a telecommunications infrastructure that is well documented and easily managed by the administrator.
- B. Note: For specific criteria concerning GIS/GPS datum, refer to the OASIS Standards document maintained by direction under the HAS Planning Design and Construction department. Said datum is not specific to the Information Technology department and thus will not be replicated here.

#### 1.4 LIFE OF THE STANDARD

- A. This standard is a living document. The criteria contained in this standard are subject to revision without notice, as warranted by advances in administration techniques related to telecommunications technology.



- B. This manual is the property of the Houston Airport System. The contents of this manual are proprietary and should not be copied or disclosed without prior written permission of the Houston Airport System. Any variation from the standards in this manual should be addressed by the Houston Airport System IT GIS contact listed below for approval prior to implementation on a project

Brandon Williams	Jay Kabouni	Li Sun
IT Project Manager	Systems Consultant	Senior GIS Analyst
Technology Infrastructure	Technology Infrastructure	Technology Infrastructure
Houston Airport System 281-233-1394 <a href="mailto:brandon.williams@houstontx.gov">brandon.williams@houstontx.gov</a>	Houston Airport System 281-233-1660 <a href="mailto:jay.kabouni@houstontx.gov">jay.kabouni@houstontx.gov</a>	Houston Airport System 281-233-1169 <a href="mailto:Li.Sun@houstontx.gov">Li.Sun@houstontx.gov</a>

#### 1.5 GENERAL

- A. This standard specifies the GIS inventory and documentation requirements for the Houston Airport System IT Telecommunications Infrastructure, Network Engineer and associated information databases. Areas of the infrastructure and/or databases to be inventoried, administered, monitored or maintained include:
1. Terminations for the telecommunications media located in work areas, telecommunications closets, equipment rooms, and entrance facilities;
  2. Equipment/devices hosting physical terminations;
  3. Telecommunications media (cable) between terminations;
  4. Pathways (spans) between terminations that contain the media;
  5. Spaces (structures) where terminations are located;
  6. Bonding/grounding as it applies to telecommunications;
  7. Geophysical plant networks i.e., manhole, handhole, pullbox, cabinet, pedestal, building access points;
  8. Splice enclosures.
  9. NOTE: Whereas this document provides an outline and overview of the GIS documentation process, the following Telecommunications Infrastructure Specifications for the Houston Airport System should be referenced for detailed administrative requirements:

- B. This standard also specifies requirements for the collection, organization, and presentation of as-built data.
- C. In addition to providing requirements and guidelines for a traditional paper-based documentation system, this standard will serve as the reference for all associated computer-based administration tools.
- D. Contracting parties, by this standard, are required to attend an HAS-IT coordination meeting prior to commencement of any documentation effort; the scope of work and project expectations will be discussed at length. You will be given additional direction as required and any useful maps, diagrams, numerical sequences, etc. will be provided to you at this time.

## 1.6 REFERENCES

- A. The latest published version at the date of contract applies to all references. Related Documents include all Drawings and General Provisions of the Contract. In Conflict between contract documents, the most stringent will be applied.
- B. Related Specifications: Use these Specifications for all related work not specifically covered in this specification.
  - 1. Section 270526: Telecommunication Grounding and Bonding
  - 2. Section 270543: Exterior Communication Pathways
  - 3. Section 270553: Identification and Labeling of Communication Infrastructure
  - 4. Section 271500: Horizontal Media Infrastructure
  - 5. Section 272200: PC, Laptop, Servers and Equipment

## 1.7 DEFINITIONS

- A. This section contains definitions of terms, acronyms, abbreviations, and formats that have special technical meaning or that are unique to the technical content of this standard.
- B. For the purposes of this standard, the following definitions apply:
  - 1. Assignment
    - a. A unique designation assigned to a person who is expected to use the circuit, equipment, service, etc., serving a particular work area. Examples of an assignment: telephone number, a name, a circuit number or a logical address.
  - 2. Backbone
    - a. Network of copper and fiber connections between termination panels/switches.
  - 3. Cable
    - a. An assembly of one or more copper conductors or optical fibers within an enveloping
    - b. sheath, constructed so as to permit use of the conductors singly or in groups.

4. Campus
  - a. The buildings and grounds have legal contiguous interconnection. (TIA)
5. Equipment
  - a. Generally, an endpoint for cable lengths; any hardware device/component. Used to
  - b. terminate cable for cross-connection or interconnection to other cables or devices.
6. Grounding electrode conductor
  - a. The conductor used to connect the grounding electrode to the equipment grounding
  - b. conductor and/or to the grounded conductor of the circuit at the service equipment or at the source of a separately derived system.
7. Handhole (HH)
  - a. A structure similar to a small maintenance hole in which cable can be pulled, but not large enough for a person to fully enter to perform work.
8. Identifier
  - a. An item of information that links a specific element of the telecommunications infrastructure with its corresponding record. (TIA)
9. Linkage
  - a. A connection between a record and an identifier or between records.(TIA)
10. Location
  - a. A position occupied or available for occupancy within a site or infrastructure network.
11. Manhole (MH)
  - a. A vault located in the ground or earth as part of an underground duct system and used to facilitate placing, establishing connections and maintenance of cables as well as placing associated equipment, in which it is expected that a person will enter to perform work. (TIA).
12. Outlet box (telecommunications)
  - a. A metallic or nonmetallic box mounted within a floor, wall or ceiling and used to hold telecommunications outlet/connectors or transition device. (TIA)
13. Outlet / connector (telecommunications)
  - a. A connecting device in the work area on which horizontal cable or outlet cables terminates. (TIA)
14. Pathways
  - a. A raceway, conduit, sleeve, or exposed location, for the placing of telecommunications cable that links telecommunications spaces together.

15. Record
  - a. The permanent documentation of installed telecommunications infrastructure obtained from as-builts.
16. Record drawing (as-built)
  - a. The documentation of measurements, location, and quantities of material work performed. May be in the form of marked up documents or other work order forms.
17. Report
  - a. A presentation of a collection of information from various records.
18. Site
  - a. Spatial location of an actual or planned structure or set of structures.
19. Span
  - a. A raceway, conduit, sleeve, or exposed location, for the placing of telecommunications cable that links telecommunications spaces together.
20. Splice
  - a. A joining of conductors meant to be permanent. (TIA)
21. Splice box
  - a. A box, located in a pathway run, intended to house a cable splice.(TIA)
22. Splice enclosure
  - a. A device used to protect a cable or wire splice.(TIA)
23. Structure
  - a. Generally an endpoint for span lengths; i.e., manhole, handhole, cabinet, junction box, pedestal, building access point, communications rooms, work areas.
24. Structure unit
  - a. A component of the structure; usually housing equipment i.e., cabinet, rack.
25. Telecommunications
  - a. Any transmission, emission, or reception of signs, signals, writings, images, and sounds; that is, information of any nature by cable, radio, optical or other electromagnetic systems. (TIA)
26. Telecommunications infrastructure
  - a. The components (telecommunications spaces, cable pathways, grounding, wiring and termination hardware) that together provide the basic support for the distribution of all telecommunications information.
27. Telecommunications media
  - a. Wire, cable, or conductor used for telecommunications.

- 28. Telecommunications space
  - a. Areas used for the installation and termination of telecommunications equipment and cable, e.g., telecommunications closets, work areas, false ceilings, and manholes/handholes.
- 29. Termination position
  - a. A discrete element of termination hardware where telecommunications conductors are terminated.
- 30. Work area; (work station)
  - a. A building space where the occupants interact with telecommunications equipment.(TIA)

## 1.8 DOCUMENTATION CONCEPTS

- A. This section describes the concepts of identifiers, records, linkages among records, and presentation of information necessary to administer infrastructure cable, spans and structures.

## 1.9 IDENTIFIERS

- A. An identifier is assigned to an element of the telecommunications infrastructure to link it to its corresponding record. Identifiers shall be marked at the elements to be administered.
- B. Identifiers used to access record sets of the same type shall be unique. For example, each identifier for each one of the set of cable records shall be unique. Unique identifiers across all types of telecommunications records are mandatory. For example, no cable record identifier should be identical to any pathway record identifier.
- C. Labeling is the marking of an element of the telecommunications infrastructure with an identifier and (optionally) other relevant information. Labeling shall be accomplished in either of two ways: separate labels may be securely affixed to the element to be administered, or the element itself may be marked.

## 1.10 RECORDS

- A. A record is a collection of information about or related to a specific element of the telecommunications infrastructure.
- B. Elements identified as required information and required linkages shall constitute the minimum requirements for these records. Specific information and other linkages suggest additional elements that may be useful to the administrative system, such as cable length.
- C. Telecommunications records are typically used in conjunction with other records. For example, a user record or assignment may contain an identifier to the record of the cable that serves an individual's workspace. Conversely, a cable record may also contain an identifier for a user record or assignment.

- D. By this standard, the Houston Airport System utilizes AutoCAD and ArcGIS as the software platforms by which all telecommunications infrastructure records and linkages are recorded and maintained.

#### 1.11 RELATIONSHIPS

- A. Relationships are the logical connections between identifiers and records. The records for infrastructure elements shall be interlinked. For example, in a cable record, termination port identifiers point to specific termination port records that contain additional information about each of the cable termination ports.

#### 1.12 ASSIGNMENT

- A. An “assignment” is a specific term of reference that allows the association of the end location, cable pairing record or termination port record with additional information. For example, an assignment such as a telephone number or circuit number can associate a user with elements of the telecommunications infrastructure. This aids in troubleshooting by identifying both the physical and logical connectivity from a single circuit assignment.

#### 1.13 PRESENTATION OF INFORMATION

- A. A typical documentation system includes labels, records, reports, drawings, and work orders. Reports compile and present information found in the records. Graphical information regarding the relationship of the telecommunications infrastructure to other infrastructures within the campus or site is presented in drawing format. Work orders document the operations needed to implement changes affecting the telecommunications infrastructure.
- B. Reports present information selected from the various telecommunications infrastructure records. Reports may be generated from a single set of records or from several sets of interlinked records.
- C. Drawings are used to illustrate different stages of telecommunications infrastructure planning and development. Generally, conceptual and installation drawings supply input to the record drawings that graphically document the telecommunications infrastructure. These record drawings as well as some equipment schedules and installation drawings (i.e., rack layouts) become part of the administration system documentation.
- D. drawings (i.e., one-line or riser diagrams) are used to illustrate the proposed design intent. They do not typically include all telecommunications infrastructure elements or identifiers and do not necessarily become part of the administration documentation.
- E. Installation or bid drawings are used to document (graphically) the telecommunications infrastructure to be installed. They should illustrate relevant infrastructure elements and may also describe the means of installation. Identifiers may or may not be included on the drawings.
- F. Record drawings (as-builts) graphically document the installed telecommunications infrastructure through floor plans, elevation, and detail drawings. These drawings may

differ from installation drawings because of changes and specific site conditions. Key elements of the telecommunications infrastructure shall have identifiers assigned. The span/structure and wiring portions of the infrastructure each may have separate drawings if warranted by the complexity of the installation or the scale of the drawings.

- G. ESRI (ArcGIS) formatted feature class and feature class layers graphically depict data in a spatial environment and are linked via physical relationship protocols established by the administrator through the utilization of software engineered towards GIS applications.

#### 1.14 WORK ORDERS (SYMANTEC)

- A. Work orders document the actions needed to implement changes affecting the telecommunications infrastructure as it was actually installed. The changes may involve several telecommunications components as well as other related systems. The Documentation Team utilizes Symantec software as its change-management notification platform. Typical Symantec tickets document actions such as moving a patch cord, installing a conduit, cross-connect or relocating an outlet box. A Symantec ticket may involve structures, spans, cable, splices, terminations, or grounding, either individually or in combination. A Symantec ticket should list both the personnel responsible for the physical action and those responsible for updating various portions of the documentation to assure its accuracy. Prior to commencement of an action that would result in a change to any telecommunications infrastructure component or related system; a Symantec ticket should be submitted in accordance with departmental and operational requirements.

#### 1.15 SUMMARY

- A. This section has presented basic concepts of documentation for the Houston Airport System Telecommunications Infrastructure. The sections that follow specify the administration of each of the components of the infrastructure in greater detail.

- a) PART 2 – PRODUCTS
- b) PART3 – EXECUTION

#### 1.16 3.1 DATA COLLECTION AND ADMINISTRATION CONCEPTS

- A. This section describes the documentation of assets within the **administrative** jurisdiction of the Houston Airport System - Public Safety and Information Technology department. As changes are made to the assets, affected labels, records, reports and drawings shall be updated or revised.
- B. The following outline assumes that the contracting parties understand the GIS/GPS datum specifications and requirements as provided in the OASIS standards. Further, that the equipment to be used towards gathering the data has been configured accordingly.

1.2 3.2 STRUCTURES

A. Standard structures

1. Manhole
2. Handhole
3. Pullbox
4. Cabinet (Pole Mounted, Pedestal)
5. Building Access
6. Dog House
7. Remote Location
8. Entrance Facility
9. Workspace
10. Main Distribution Frame (MDF)
11. Building Distribution Frame (BDF)
12. Intermediate Distribution Frame (IDF)
13. Point of Presence (POP)
14. Pathway Transition
15. Aerial Pole

B. Identification

B.

1. Each Structure has been assigned a unique GIS database identifier. This identifier serves as a primary-key for each database record. Each record contains additional fields and values relative to the feature identified by the primary-key.
1. All structure identifiers follow a specific schema; new structures must be identified accordingly. In the event that a determination cannot be made regarding the identification of a structure, please contact an HAS IT GIS representative prior to documenting.
2. All structures are identified through a numerical range with prefix characters specific to a respective airport campus, technology asset designation, and feature-category.
3. Airport Campus Characters:
  - a. IAH: I
  - b. HOU: H
  - c. EFD: E
4. Asset Designation Character:
  - a. Technology: T
5. Feature-Category Characters:
  - a. Structure: S
  - b. Pathway: P
  - c. Equipment: E
  - d. Cable: C
6. Numerical Range:
  - a. 0000 – 9999
7. Example:
  - a. ITS0054 (IAH Structure), HTS0054 (HOU Structure), ETS0054 (EFD Structure)
8. Manhole Numerical Range:



- a. Note: When planning to identify newly constructed or newly placed HAS assets, the contractor is expected to coordinate with the HAS IT GIS staff prior to labeling. This action will account for all identifiers previously assigned and prevent duplications or omissions.

C. Labeling

D.

1. Labeling should follow the identification schema and further be accomplished via an approved method described below.
1. Newly constructed structures (manhole, handhole, pullbox, cabinet) will require that their identifiers be etched onto the lid or affixed with an appropriate label material. Manholes and handholes should be stamped on the lid itself, as well as the metal ring/material surrounding the opening; or the concrete foundation (topside). Utilize an appropriate chisel or stamp, or labeling device to accomplish the task.
2. The Technology Infrastructure group does not maintain the specification for labeling newly constructed structures (dog house, remote location, entrance facility, workspace, MDF, BDF, IDF, POP, Pole). These should be placarded according to current HAS Infrastructure specification. The Technology Infrastructure GIS identifiers (described in the previous paragraphs) relevant to these spaces and locations are preserved for GIS database record keeping purposes only. Contact an HAS Infrastructure representative for clarification on physical labels for architectural spaces.
3. Required Fields
4. Each structure requires that specific data be collected per unit. GPS equipment should be formatted to account for this information:
  - a. TELECOM\_ID
  - b. COORD\_X
  - c. COORD\_Y
  - d. COORD\_Z
  - e. AIRPORT
  - f. AGENCY
  - g. LID\_TYPE
  - h. DEPTH\_INCH
  - i. SPLICE\_CLOSURE
  - j. SLACK\_LOOP
  - k. GROUNDING
  - l. COMMENTS
  - m. BUILDING\_NAME
  - n. LEGACY\_ID
  - o. STRUCTURE\_TYPE
  - p. STRUCTURE\_SUBTYPE
  - q. HAS\_LEVEL
  - r. LID\_SIZE
  - s. PROJECT
  - t. COLLECTION\_DATE
  - u. LID\_SHAPE
  - v. LID\_MATERIAL
  - w. PROJECT\_CLASS

C. GPS

E.

1. Each manhole should be recorded as follows:
2. Single shots; taken on-center. Offset shots are acceptable for manholes not available to satellite coverage but these shots must be coordinated with an HAS-IT GIS contact prior to.

F. Supporting documentation deliverables

G.

1. Additional documentation records are required to support GPS data. The documentation is as follows:
2. Manholes and Handholes only
3.
  - a. Digital photos – top (north to top of photo), north wall, west wall, south wall, east wall; for manholes not true to cardinal compass points adjust call-outs as necessary.
  - b. AutoCAD – butterfly diagram of manhole depicting pathway orientation, conduit layout, innerduct configurations, cabling locations, and cabling counts for each manhole unit in both .dwg 2010 or higher and .pdf formats; (See manhole AutoCAD butterfly exhibit; see also the OASIS standards for IT specific AutoCAD layering).
  - c. Video – 360 degree imagery of interior; .mpg format.
4. Communication Room
5.
  - a. AutoCAD – floorplan (where applicable) layouts of structure units depicting orientation, and/or configurations in both .dwg 2010 or higher and .pdf formats; (See AutoCAD communications room exhibit).
6. Spatial Data Deliverables
7.
  - a. The entire manhole inventory should be delivered separately in ArcGIS feature class (version 10) format along with any records outlined in the ‘Supporting Documentation’ paragraph. This feature class (STRUCTURE) should contain the attribute values from the ‘Required Fields’ paragraph.
8. Special Instructions
9.
  - a. None

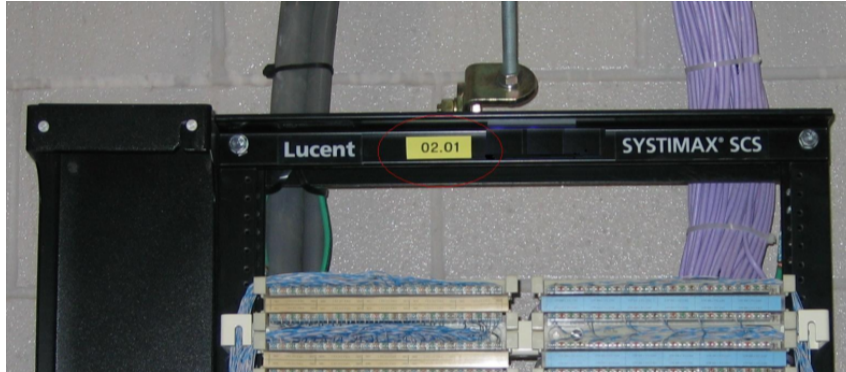
3.3 CABINETS/RACKS

A. Identification

10. Each cabinet/rack has been assigned a unique campus identifier. All structure identifiers follow some specific schema; new structures must be identified accordingly. In the event that a determination can not be made regarding the identity of the structure, please contact the HAS IT GIS representative prior to documenting.
11. All cabinets are identified through a numerical range specific to its respective campus and should be prefixed with 'PC' (pedestal cabinet) or 'PM' (pole mounted cabinet). The ranges are as follows:
12. Example:
  - a. ITS0054.02.01
    - 1) Translation: Cabinet or Rack in Room (Structure) ITS0054, row 02, column or position 01.
  - b. ITS0054.BB01
    - 1) Translation: Backboard (plywood) 01 in Room (Structure) S103.1.  
1)
2. Note: Backboards tend to be randomly arranged within the structure and are usually not numbered according to wall orientation. Different identifiers are however assigned to each. Any one backboard could host a wide assortment of equipment; see EQUIPMENT for identifier schemas.
3. Note: Future expansion of rows should be a major consideration during identifier/labeling phase; numbering from low to high in the direction of any available space.

#### B. Labeling

1. Labeling should follow the identification schema and further be accomplished via the use of below specified labeling device or approved equivalent:
13.
  - a. DYMO RhinoPRO 5000 Industrial Label Maker
  - b.  $\frac{3}{4}$ " Flexible Industrial Strength Nylon label tape – yellow
2. Labels should be affixed to the cabinet housing.
3. Labels should be affixed to top-center of identified structure unit. For labeling purposes only, the structure identifier can be omitted from the structure unit identifier to minimize space required for the label. It will be assumed that all structure units located in the same structure will carry the same structure identifier. Note: this is for labeling purposes only; data collection records/tables must use complete identifier including telecom structure identifier.



- C. Required Fields
  - 1. No Action required
- D. GPS
  - 1. No Action required
- E. Supporting Documentation Deliverables
  - 1. AutoCAD – floorplan and rackface layouts of structure units depicting orientation, and/or configurations in both .dwg 2010 or higher and .pdf formats; (See AutoCAD communications room exhibit)
- F. Spatial Data Deliverables
  - 1. No Action require
- G. Special Instructions
  - 1. Structure units are visibly marked with a reference tag identifying its column and row. The telecom structure (ITS, HTS, ETS) is omitted from the reference tag but should be included in the structure unit tables. Newly placed structure units will require that their identifiers be affixed to the cabinet face or rack frame. Utilize specified labeling device to accomplish the task.

### 3.4 PATHWAYS

- 1. Ductbank
  - 14. Trench
  - 15. Direct Buried
  - 16. Cable Tray
- A. Identification
    - 17. Each Pathway has been assigned a unique GIS database identifier. This identifier serves as a primary-key for each database record. Each record contains additional fields and values relative to the feature identified by the primary-key.
    - 18. All pathway identifiers follow a specific schema; new pathways must be identified accordingly. In the event that a determination cannot be made regarding the identification of a pathway, please contact an HAS IT GIS representative prior to documenting.

19. All pathways are identified through a numerical range with prefix characters specific to a respective airport campus, technology asset designation, and feature-category.
  1. Airport Campus Characters:
    - a. IAH: I
    - b. HOU: H
    - c. EFD: E
  20. Asset Designation Character:
    - a. Technology: T
  21. Feature-Category Characters:
    - a. Structure: S
    - b. Pathway: P
    - c. Equipment: E
    - d. Cable: C
  22. Numerical Range:
    - a. 0000 – 9999
  23. Example:
    - a. ITP0054 (IAH Pathway), HTP0054 (HOU Pathway), ETP0054 (EFD Pathway)

#### H. Labeling

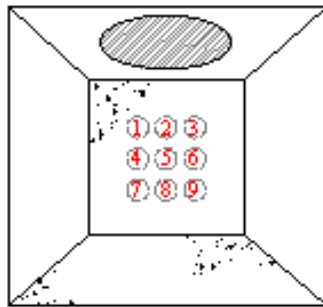
1. Pathways are identified for the purposes of GIS referencing and are linked to structure inventories but are not physically labeled per current guidelines.

#### I. Required Fields

1. Each pathway requires that specific data be collected per unit. GPS equipment should be formatted to account for this information.
  - a. CONDUIT\_SIZE
  - b. COMMENTS
  - c. AIRPORT
  - d. HAS\_ENCASMENT
  - e. AGENCY
  - f. CONDUIT\_QTY
  - g. PATH\_ID
  - h. PATH\_NUMBER
  - i. PATH\_TYPE
  - j. END1\_COORD\_X
  - k. END1\_COORD\_Y
  - l. END1\_COORD\_Z
  - m. END2\_COORD\_X
  - n. END2\_COORD\_Y
  - o. END2\_COORD\_Z
  - p. HAS\_LEVEL
  - q. COLLECTION\_DATE
  - r. PROJECT
  - s. TICKET
  - t. LEGACY\_ID
  - u. PATHWAY\_MATERIAL

- v. FROM\_TELECOM\_ID
  - w. TO\_TELECOM\_ID
  - x. TELECOM\_ID
  - y. PROJECT\_CLASS
  - z. DEPTH\_END1
  - aa. DEPTH\_END2
  - bb. GPS
2. Each pathway must be recorded as follows:
- a. Care should be taken to accurately locate the pathways prior to commencing with documentation.
  - b. Continuous-line shots; taken on center. Line-shots should begin and end on-center of endpoint (structure) locations.
- J. Spatial Data Deliverables
- 1. The entire pathway inventory should be delivered separately in ArcGIS feature class (version 10.x) format along with any records outlined in the 'Supporting Documentation' paragraph. This feature class (PATHWAY) should contain the attribute values from the 'Required Fields' paragraph.
- K. Special Instructions
- 1. No action required
- L. 3.5 CABLE TRAY
- A. Identification
- 1. no requirements per current guidelines
- M. Required Fields
- 1. no requirements per current guidelines
- N. GPS
- 1. no requirements per current guidelines
- O. Supporting Documentation Deliverables
- 1. no requirements per current guidelines
- P. Spatial Data Deliverables
- 1. no requirements per current guidelines
- Q. Special Instructions
- 1. no requirements per current guidelines
- 3.5 PATHWAY UNITS
- A. Conduit Identification
- 2. For deliverable purposes conduits are only being depicted via AutoCAD formats; i.e. butterfly diagrams or floorplans (see Exhibits: Communication Room Exhibit, Rackface Exhibit)

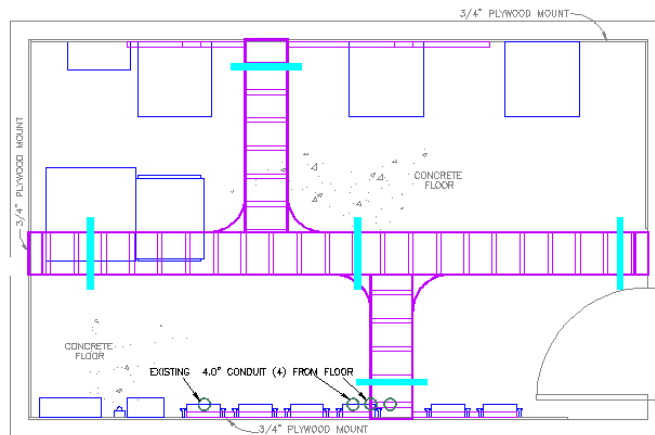
3. In the outside plant environment, conduits should be identified where applicable by size, location and position relative to their endpoints (structures) i.e. handhole wall, building access point, etc.
4. Further, on manhole / handhole butterfly diagrams, OSP conduits are depicted relevant to their size, position and orientation. As a general rule, conduits are identified left-to-right and top-to-bottom as you're facing the wall to be inventoried and should be prefixed with 'CD' on the AutoCAD documents.



MANHOLE

- R. For the purposes of illustration and to be included as part of the manhole butterfly diagram draft document, each wall should identify the following:
  - S. Ductbank (Telecom Pathway Identifier for each respective manhole / handhole wall face)
  - T. Conduits (Count, Orientation)
  - U. Cabling (Telecom Cable Identifier, Cable Type, Cable Count, location within respective conduit)
- V. In the inside plant environment, conduits should be identified where applicable by position and location relative to their endpoints (telecom structures) i.e. communications rooms, vaults
- W. ISP conduits are depicted on communication-room AutoCAD layouts as to their position and orientation; and are not numbered.

X. Example:



Y. Labeling

1. Not physically labeled per current guidelines.

Z. Required Fields

1. Conduit counts, and size as prescribed in the pathway sub-topic

AA. GPS

1. No action required

BB. Supporting Documentation Deliverables

1. AutoCAD manhole / handhole butterfly diagrams for OSP conduits and communication-room layouts for ISP conduits; (See manhole / handhole AutoCAD butterfly exhibit.).

CC. Spatial Data Deliverables

1. No action required

DD. Special Instructions

1. See note regarding annotation above.

3.6 CABLE

1. Inside Plant Copper
2. Inside Plant Fiber (Single-Mode, Multi-Mode)
3. Outside Plant Copper
4. Outside Plant Fiber (Single-Mode, Multi-Mode)
5. Inside Plant Copper Coax
6. Outside Plant Copper Coax
7. Inside Plant Hybrid
8. Outside Plant Hybrid

A. Identification



9. Each Cable has been assigned a unique GIS database identifier. This identifier serves as a primary-key for each database record. Each record contains additional fields and values relative to the feature identified by the primary-key.
10. All cable identifiers follow a specific schema; new cable must be identified accordingly. In the event that a determination cannot be made regarding the identification of a cable-run, please contact an HAS IT GIS representative prior to documenting.
11. All cables are identified through a numerical range with prefix characters specific to a respective airport campus, technology asset designation, and feature-category.
  - a. Airport Campus Characters:
    - 1) IAH: I
    - 2) HOU: H
    - 3) EFD: E
  - b. Asset Designation Character:
    - 1) Technology: T
  - c. Feature-Category Characters:
    - 1) Structure: S
    - 2) Pathway: P
    - 3) Equipment: E
    - 4) Cable: C

EE.

1. Numerical Range:
  - a. 0000 – 9999
2. Example:
  - a. ITC0054 (IAH Cable), HTC0054 (HOU Cable), ETC0054 (EFD Cable)
3. Note: When planning to identify newly constructed or newly placed HAS assets, the contractor is expected to coordinate with the HAS IT GIS staff prior to labeling. This action will account for all identifiers previously assigned and prevent duplications or omissions.

FF. Labeling

1. Labels should be affixed to all connection ends of identified cable and on any visible length at key access points, i.e. manhole, handhole cable ladder runs.
2. "All adhesive inside/outside plant cable labels for horizontal and backbone cables shall be covered with clear heat shrink tubing"

GG. Each cable requires that specific data be collected per unit. GPS equipment should be formatted to account for this information.

1. TELECOM\_ID
1. LEGACY\_ID
2. AIRPORT
3. AGENCY
4. CABLE\_TYPE
5. CABLE\_COUNT
6. FROM\_TELECOM\_ID
7. TO\_TELECOM\_ID
8. FROM\_STRUCTURE\_UNIT\_ID
9. TO\_STRUCTURE\_UNIT\_ID

10. FROM\_EQUIPMENT\_ID
11. TO\_EQUIPMENT\_ID
12. HAS\_LEVEL
13. PROJECT
14. PROJECT\_CLASS
15. COLLECTION\_DATE
16. SYMANTEC\_TICKET
17. COMMENTS
18. GPS

HH. OSP – continuous GPS shot between identified structures

II. ISP – conventional GPS services are unavailable inside-plant; therefore inside-plant cabling will need to be digitized and included in the ArcGIS CABLE feature class spatial data deliverable.

JJ. Supporting Documentation Deliverables

KK. ISP Horizontal cabling (see Exhibits – iPatch SOP.pdf).

LL. Cable testing records; .pdf format (see Exhibits – C\_Cable Test Exhibit, F\_Cable Test Exhibit.pdf).

MM. Butterfly diagrams (OSP) AutoCAD format; (See AutoCAD manhole / handhole butterfly exhibit).

NN. Spatial Data Deliverables

1. The entire OSP cable inventory should be delivered separately in ArcGIS feature class (version 10.x) format along with any records outlined in the 'Supporting Documentation' paragraph. This feature class (CABLE) should contain the attribute values from the 'Required Fields' paragraph.
2. No Spatial Data required for ISP inventory.

OO. Special Instructions

1. No cable testing should be conducted on any live circuit. Ensure that necessary precautions are observed to guarantee existing network integrity and no active circuits are impacted.

PP. 3.7 JUMPER CABLES / PATCH CORDS / CROSS-CONNECTS:

A. Identification

1. No action required

QQ. Labeling

1. No action required

RR. Required Fields

1. Refer to iPatch SOP (see Exhibits - iPatch SOP.pdf)

SS. GPS

1. No action required

TT. Supporting Documentation Deliverables

1. ISP cabling (see Exhibits - iPatch SOP.pdf)

UU. Spatial Data Deliverables

1. No action required

VV. Special Instructions

1. No cable testing should be conducted on any live circuit. Ensure that necessary precautions are observed to guarantee existing network integrity and no active circuits are impacted.
2. As iPatch is the administration application for these assets - all project managers, inspectors and consultants overseeing 'new-build' infrastructure configurations must strictly adhere to guidelines specified in the iPatch SOP (see Exhibits - iPatch SOP.pdf). Further, you must contact an iPatch database administrator directly to coordinate the data collection and documentation-deliverable evolution.
3. Bulk import of key iPatch modeling components can be facilitated by utilization of a specifically formatted spreadsheet (see Exhibits - iPatch Bulk Import.xls).
4. Updates/changes to fiber patching can be facilitated by utilization of a specifically formatted cut-sheet (see Exhibits – Fiber Patching Cut Sheets.xls).

WW. 3.8 EQUIPMENT

A. Termination Point

1. Patch Panel
2. Network Switch
3. 110 Block
4. Splice Enclosure
5. Cable Transition
6. EFSO Button
7. Copper Modem
8. Tap
9. Camera

XX. Identification

1. All Equipment has been assigned a unique GIS database identifier. This identifier serves as a primary-key for each database record. Each record contains additional fields and values relative to the feature identified by the primary-key.
2. All equipment identifiers follow a specific schema; new equipment must be identified accordingly. In the event that a determination cannot be made regarding the identification of a piece of equipment, please contact an HAS IT GIS representative prior to documenting.
3. All equipment is identified through a numerical range with prefix characters specific to a respective airport campus, technology asset designation, and feature-category.
4. Airport Campus Characters:
  - a. IAH: I
  - b. HOU: H
  - c. EFD: E

5. Asset Designation Character:
  - a. Technology: T
6. Feature-Category Characters:
  - a. Structure: S
  - b. Pathway: P
  - c. Equipment: E
  - d. Cable: C
7. Numerical Range:
  - a. 0000 – 9999
8. Example:
  - a. ITE0054 (IAH Equipment), HTE0054 (HOU Equipment), ETE0054 (EFD Equipment)

YY. Labeling

1. Labeling should follow the identification schema and further be accomplished via the use of below specified labeling device or approved equivalent:
  - a. DYMO rhinoPRO 5000 Industrial Label Maker
  - b. 3/4" Flexible Industrial Strength Nylon label tape - yellow
2. Labels should be affixed to the splice enclosure housing.
3. Label placement should be affixed to or as near to equipment as possible.

ZZ. Required Fields

1. All equipment requires that specific data be collected per unit. GPS equipment should be formatted to account for this information.
  - a. EQUIPMENT\_ID
  - b. TELECOM\_ID
  - c. SYMANTEC\_TICKET
  - d. CABLE\_ID
  - e. TELECOM\_CABLE\_ID
  - f. LEGACY\_CABLE\_ID
  - g. AIRPORT
  - h. AGENCY
  - i. PROJECT
  - j. PROJECT\_CLASS
  - k. COLLECTION\_DATE
  - l. COMMENTS
  - m. LEGACY\_ID
  - n. EQUIPMENT\_TYPE
  - o. HAS\_LEVEL

AAA. GPS

1. No action required for ISP equipment
2. Each splice enclosure (OSP) should be recorded as follows:
3. Single shots; taken on-center. Offset shots or other means of location are acceptable for splice enclosures not available to satellite coverage but these shots or options must be coordinated with an HAS-IT GIS contact prior to.

BBB. Supporting Documentation Deliverables

1. AutoCAD – one-line diagram of ACCESSIBLE for splice enclosures depicting cable identifiers, connections and cable counts for each splice enclosure in both .dwg 2010 or higher and .pdf formats; (See AutoCAD splice enclosure exhibit).
2. AutoCAD – rackface layouts of structure units depicting orientation, and/or configurations in both .dwg 2010 or higher and .pdf formats; (See AutoCAD communications room exhibit).

#### CCC. Spatial Data Deliverables

1. The entire equipment inventory should be delivered separately in ArcGIS feature class (version 10.x) format along with any records outlined in the ‘Supporting Documentation’ paragraph. This feature class (EQUIPMENT) should contain the attribute values from the ‘Required Fields’ paragraph.

#### DDD. Special Instructions

1. Do not attempt to open a splice enclosure that appears to be in a fragile state or does not provide for ready access (sealed). Note in ‘comments’ field that the enclosure was inaccessible.
2. Do not move, adjust ‘live’ equipment in order to identify or label. Ask for assistance from qualified HAS Technology Infrastructure personnel.
3. Do not disconnect cabling in order to identify or label. Ask for assistance from qualified HAS Technology Infrastructure personnel.

#### EEE. 3.9 OUTLETS

##### A. Identification

1. Each outlet-faceplate is identified specific to its servicing IDF; regardless of the number of outlets within a given location. All outlet-faceplate ports are labeled to correspond with the servicing IDF panel port. Note: These space identifiers are architectural identifiers, and are designated by reference to the HAS Infrastructure schema for identifying building spaces. This is not a GIS Technology Infrastructure database identifier.
2. Example Outlet-Faceplate Identifier:
  - a. S103.1
    - 1) Translation: Outlet serviced by IDF S103.1
3. In the event that a determination cannot be made regarding the identity of the outlet, please contact the HAS IT GIS representative prior to documenting.
4. Note: When planning to identify newly constructed or newly placed HAS assets, the contractor is expected to coordinate with the HAS IT GIS staff prior to labeling. This action will account for all identifiers previously assigned and prevent duplications or omissions.

##### B. Labeling

5. Outlet label placement 2-port: under top-aligned, Plexiglas cover – servicing IDF identifier over port identifiers. Ports should be identified left-to-right.



6. Outlet label placement 3-port: under top-aligned, Plexiglas cover – servicing IDF identifier over port identifiers. Ports should be identified left-to-right. Under bottom-aligned, Plexiglas cover – servicing IDF identifier over port identifiers. Ports should be identified left-to-right.
7. Outlet label placement 4-port: under top-aligned, Plexiglas cover – servicing IDF identifier over port identifiers. Ports should be identified left-to-right. Under bottom-aligned, Plexiglas cover – servicing IDF identifier over port identifiers. Ports should be identified left-to-right. Follow 3-port example.



8. Outlet label placement 6-port: under top-aligned, Plexiglas cover – servicing IDF identifier over port identifiers. Ports should be identified left-to-right. Any mid-faceplate ports will require an adhesive label - servicing IDF identifier over port identifiers. Ports should be identified left-to-right. Under bottom-aligned, Plexiglas

cover – servicing IDF identifier over port identifiers. Ports should be identified left-to-right. These types of outlets are ‘Non-Standard’.

FFF. Required Fields

1. No action required

GGG.GPS

1. OSP – No GPS action required
2. ISP – No GPS action required

HHH. Supporting Documentation Deliverables

1. Additional documentation records are required to support iPatch data. The documentation is as follows:
2. AutoCAD – floorplan (where applicable) depicting outlet locations; (See AutoCAD communications room exhibit.).

III. Spatial Data Deliverables

1. No action required

JJJ. Special Instructions

1. Outlets are visibly marked with a reference tag indicating the outlet identifier. Additionally any port associated to the outlet is identified with a port number related specifically back to its respective servicing equipment. Newly placed outlets will require that their identifiers be affixed to the outlet face. Utilize specified labeling device to accomplish the task.

KKK. 3.10 DOOR CONTACTS

A. Identification

1. Each door-contact sensor (without card-reader) is identified by an alpha-numeric sequence specific to its location. All door-contact identifiers are coded with building or complex character, followed by level character, followed by numerical sequence character, followed by ‘CCM’ designation. ‘CCM’ is an acronym for ‘Control Contact Monitoring.’
2. Example Outlet-Faceplate Identifier: B-2057CCM
  - a. Translation:
  - b. B (building/complex character) Terminal B
  - c. 2 (level character) Level 2
  - d. 057 (numerical sequence character) Contact # 057
  - e. CCM (CCM designation) Control Contact Monitoring
3. In the event that a determination cannot be made regarding the identity of a door contact, please contact the HAS IT Project Manager prior to documenting.
4. Note: When planning to identify newly constructed or newly placed HAS assets, the contractor is expected to coordinate with the HAS IT Project Manager prior to labeling. This action will account for all identifiers previously assigned and prevent duplications or omissions.

LLL. Labeling

1. Door-contacts (without card-reader) require identifier plates per 'Special Instruction' specification below

MMM. Required Fields

1. Coordinate with HAS security.

NNN. GPS

1. OSP – No GPS action required
2. ISP – No GPS action required

OOO. Supporting Documentation Deliverables

1. AutoCAD floorplans indicating door contact location including label plate identifier annotation

PPP. Spatial Data Deliverables

1. No action required

QQQ. Special Instructions

1. Install Black Lexan Label Plate: sized 1 ½" X 4", black background, white lettering and Door Alarm Identifier engraved (i.e. B-2057CCM). Locate plate on door frame above contact. Clean door frame prior to placement. Affix with 3M double-sided tape.
2. Provide paper and electronic copies (.pdf format) of all Electronic Lock Permits and Submittal Documents for any door requiring City of Houston door lock permit to the HAS IT Project Manager prior to Acceptance Testing.

RRR. 3.11 CARD READERS

A. Identification

1. Each electronic lock is identified by an alpha-numeric sequence specific to its location. All electronic lock identifiers are coded with building or complex character, followed by level character, followed by numerical sequence character.
2. Example Outlet-Faceplate Identifier: C-1015
3. Translation:

a.	C	(building/complex character)	Terminal C
b.	1	(level character)	Level 1
c.	015	(numerical sequence character)	Lock # 015
4. In the event that a determination cannot be made regarding the identity of a door contact, please contact the HAS IT Project Manager prior to documenting.
5. Note: When planning to identify newly constructed or newly placed HAS assets, the contractor is expected to coordinate with the HAS IT Project Manager prior to labeling. This action will account for all identifiers previously assigned and prevent duplications or omissions.

SSS. Labeling

1. Electronic locks require identifier plates per 'Special Instruction' specification below

TTT. Required Fields

1. Coordinate with HAS security.



UUU. GPS

1. OSP – No GPS action required
2. ISP – No GPS action required

VVV. Supporting Documentation Deliverables

1. AutoCAD floorplans indicating card reader location including label plate identifier annotation

WWW. Spatial Data Deliverables

1. No action required

XXX. Special Instructions

1. Install Black Lexan Label Plate: sized approximately 3 ¼" X 5 ½", black background, white lettering and Card Reader Identifier engraved (i.e. C-1015). Affix plate to single-gang cabinet with 5/32" screws.
2. Provide paper and electronic copies (.pdf format) of all Electronic Lock Permits and Submittal Documents for any door requiring City of Houston door lock permit to the HAS IT Project Manager prior to Acceptance Testing.

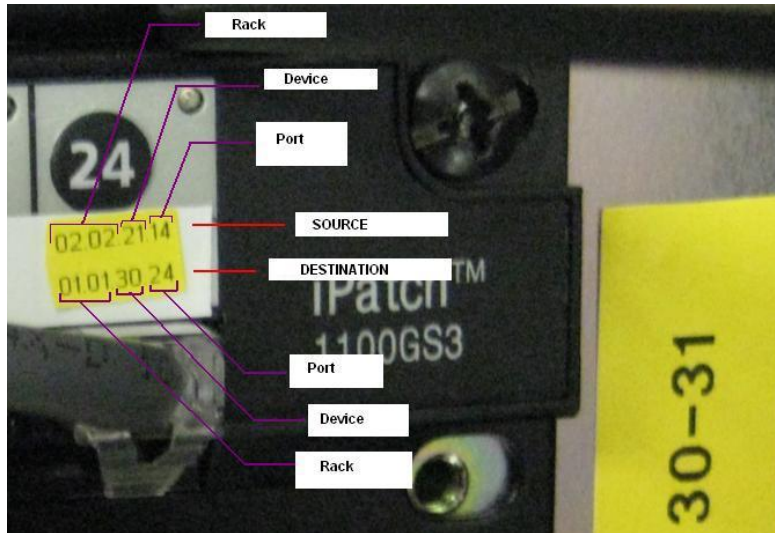
YYY. 3.12 CONNECTIONS

1. Ports

A. Identification

1. Each port has been assigned an identifier; combined with the equipment identifier, the sequence becomes unique. Therefore port identifiers may be replicated on separate pieces of equipment because again, the true and complete port ID is coupled to the equipment ID.
2. Example:
  - a. 100.20.01.02.35-39 (equipment ID) + FP03 = 100.20.01.02.35-39  
FP03
  - b. 100.25.01.01.12-17 (equipment ID) + FP03 = 100.25.01.01.12-17  
FP03
3. Fiber port 03 is replicated on two different pieces of equipment. Coupling it to the equipment ID makes the string unique
4. All ports are identified through a numerical range specific to its respective equipment. Ports may be prefixed with 'FP' (fiber port) or 'CP' (copper port) as is pertinent to the cable category and space allows on the equipment.
5. Regarding service outlets: ports are identified via reference to IDF and IDF equipment (see Outlet). This data should be recorded in the Excel data record tables.
6. Regarding termination panels: ports are identified according to equipment port capacity.
7. Regarding patch panels: ports are identified in sequence and may be prefixed with structure identifier references.
8. Regarding switches: ports are identified in sequence and may be prefixed according to cable compatibility; i.e. 'FP' or 'CP'. The port sequence should follow left-to-right and top-to-bottom.
9. Regarding devices housing multiple blades: ports are identified in sequence as related to respective blades and may be prefixed according to cable compatibility; i.e. 'FP' or 'CP'. The port sequence should follow left-to-right and top-to-bottom.

10. Regarding SYSTIMAX (iPatch) 'equipment panels': ports are identified with a source-over-destination, (panel-to-panel) schema and inclusive of rack/cabinet (structure-unit) identifiers.
11. Regarding SYSTIMAX (iPatch) 'service panels': ports are identified in sequence and may be prefixed with structure identifier references.



ZZZ.

1. All port identifiers follow some specific schema; new ports must be identified accordingly. In the event that a determination cannot be made regarding the identity of the port, please contact the iPatch database administrator prior to documenting.
2. Note: When planning to identify newly constructed or newly placed HAS assets, the contractor is expected to coordinate with the HAS IT GIS staff prior to labeling. This action will account for all identifiers previously assigned and prevent duplications or omissions.

AAAA. Labeling



BBBB.

1. Regarding switches: generally space does not allow for switch port labeling; ports must be identified however in order to correlate circuit connectivity to/from/through the device.
2. Labeling should follow the identification schema and further be accomplished via the use of below specified labeling device or approved equivalent:
  - a. DYMO rhinoPRO 5000 Industrial Label Maker
  - b. 3/4" Flexible Industrial Strength Nylon label tape - yellow

3. Labels should be affixed to applicable port locations. Not all ports allow for label placement but these ports should be identified and recorded as part of iPatch SOP; respective to cable or equipment.

CCCC. Required Fields

1. Each port requires that its relationship be established between cable and equipment via use of the iPatch cut sheet (see Exhibits – iPatch SOP.pdf).

DDDD. GPS

1. No action required

EEEE. Supporting Documentation Deliverables

1. ISP cabling/port configurations (see Exhibits – iPatch SOP.pdf)

FFFF. Spatial Data Deliverables

1. No action required

GGGG. Special Instructions

1. Careful attention should be given to accurately accounting for and recording relationships established between ports – cable, and ports – equipment.

HHHH. 3.13 STANDARD OPERATING PROCEDURES – BEST PRACTICES

A. Data Collection Methodology

1. This section includes a general outline of procedures that can be utilized towards the collection and processing of HAS' IT physical data requirements. The outline establishes some of the recommended methods which have proven to be most successful during previous data collection cycles.
2. This guide does not mandate adherence to these methods provided that the contracting party can determine a like process to produce the intended results. Said process must however provide for the specific formatting of all aforementioned physical data deliverables including data record tables, .DWF / .DWG, .PDF, feature class, feature class, and photo imagery.
3. Note: Safety is paramount and discussions with regard to OSHA and other regulatory or governing authorities including Airport Operations must be coordinated with the HAS IT representatives prior to commencement of any project scope.

III. Outside Plant

1. Identify outside plant network locations as defined by project scope of work including all structures, pathways, cable and equipment. This requires extensive communication and coordination with HAS airport campus authorities before and during the evolution. Contracting parties will be provided with respective contact information prior to commencement of data collection effort.
2. Coordinate with HAS IT representative to determine existing network identifiers and to specify any new network identifiers that must be incorporated into data deliverables.

3. If applicable to the GPS equipment that will be utilized to collect data, format custom projections to campus, format code-list.
4. GPS locate structures; ensure all attribute fields are populated. For MH, HH produce field sketch - butterfly layout depicting pathways unit counts orientation; cable types / counts, location. These field sketches should be used to create AutoCAD .DWF / .DWG deliverables.
5. Produce photo imagery
6. GPS locate all splice enclosures, slack loops.
7. Label all end-equipment, splice enclosures, slack loops, cable, pullboxes, cabinets, pedestals. Stamp all MH, HH per guidelines.
8. GPS locate pathways; ensure all attribute fields are populated.
9. Physically locate outside plant associated equipment; ensure all attribute fields are populated.
10. Building Access Points can be approximated where the PATHWAY intersects the building face for purposes of GPS data collection; single-shot.
11. GPS locate cable routing; ensure all attribute fields are populated including end-equipment identifiers.
12. QA/ QC to ensure that all data relationships have been established; i.e. equipment-structure, structure-pathways, pathways-cable and that all attribute fields have been populated.
13. Finalize, format deliverables

#### JJJJ. Inside Plant

1. Identify inside plant network locations as defined by project scope of work including all structures, cable and equipment. This requires extensive communication and coordination with HAS airport campus authorities before and during the evolution. Contracting parties will be provided with respective contact information prior to commencement of data collection effort.
1. Coordinate with iPatch database administrator to determine existing network identifiers and to specify any new network identifiers that must be incorporated into data deliverables.
2. Prepare field sketch (floorplan, rackface) of interior space and equipment. Document and dimension structure space and contents required to generate layouts for the floorplan, cable ladder, conduit, room details, and Install details. Rackface layouts should be created in a separate document. These field sketches should be used to create AutoCAD .DWF / .DWG deliverables.
3. Label all structure units, cable and equipment per guidelines.
4. Record information specific to iPatch SOP for structure units, equipment, cable; this process will be covered in depth at the coordination meeting held prior to commencement of data collection effort. This information establishes infrastructure relationships that will be used to model the communications environment.
5. Test Cable.
6. QA/ QC to ensure that all data relationships have been established; i.e. structure – structure, structure – structure units, structure units – equipment, equipment – ports, ports – cable.
7. Finalize, format deliverables.

END OF SECTION 27 05 53

## SECTION 27 15 00 - HORIZONTAL MEDIA INFRASTRUCTURE

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Provide a Structured Cabling System (SCS) for the purpose of supporting voice, data and video communications at various locations within the Houston Airport System. The Houston Airport System (HAS) has established Systimax as the standard for cabling infrastructure installations.
- B. Related Work:
  - 1. Section 27 05 53: Identification and Labeling of Communication Infrastructure
  - 2. Section 27 05 43: Underground Ducts and Raceways for Communications Systems
  - 3. Section 27 05 26: Telecommunications Grounding and Bonding

#### 1.2 SUBMITTALS

- A. Qualifications: Demonstrate compliance with requirements of Paragraph 1.05A below.
- B. Manufacturers' data, including part numbers, cut sheets and detailed descriptions, for all proposed equipment.
- C. Cable inventory data shall be submitted for all copper and termination equipment. Reference Specification 270553 for the Inside and Outside plant spread sheets. Information shall be provided on a CD.
- D. Shop Drawings to be submitted and approved before implementation is started. Shop Drawings to be submitted in accordance with Specification 01340.
- E. Record Drawings: Furnish CAD drawings, following format in Section 01340, of completed work including cable numbers. Refer to Specification 270553 for labeling conventions. Contractor's on-site Building Industry Consulting Services International (BICSI) Registered Communications Distribution Designer (RCDD) supervisor shall review, approve and stamp all shop drawings, coordination drawings and record drawings.
- F. Include spares list to be approved by HAS IT Project Manager for approval.
- G. Cable Testing and Reports.
  - 1. Submit Testing Plan prior to beginning cable testing.
  - 2. Submit certified test reports of Contractor-performed tests in accordance with paragraph 3.04. of this document.
  - 3. Electronic and hardcopy versions of test reports shall be submitted together and clearly identified with cable identification. Test results must be in both PDF and original raw format of approved tester.
  - 4. Test reports shall be reviewed, approved and with a stamped cover letter by the Contractor's on-site RCDD.
- H. Product data for all termination and test equipment to be used by Contractor to perform work.

1. Equipment shall be calibrated with traceability to National Institute of Standards and Technology (NIST) requirements.
2. Contractor shall include copy of calibration and certification that equipment calibration meets NIST standards and has been calibrated at least once in the previous calendar year.
3. Test equipment data shall be reviewed, approved and stamped by the Contractor's on-site RCDD prior to submitting.
4. Refer to 3.04. in this document for test equipment requirements.

I. Submit Technology Implementation Plan in accordance with 1.07 below.

J. Submit Cable Pulling Plan, as follows:

1. Indicate the installed backbone conduit layout in schematic format, including junction boxes and distances between junction boxes.
2. Indicate contents of each conduit.
3. Indicate the cable pulling calculations, conduit fill ratios and actual cable runs and tensions.
4. Cable Pulling Plan shall be reviewed, approved and stamped by the Contractor's on-site RCDD prior to submittal.
5. Installation of cabling shall not commence prior to approval of the pulling plan and calculations by the Architect/Engineer.

K. Submit installation plan indicating:

1. Equipment and personnel
2. Materials and staging area
3. Start and completion dates
4. Locations, including floor, room and building
5. Installation plan shall be reviewed, approved and stamped by the Contractor's on-site RCDD prior to submitting.

### 1.3 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating units without field measurements. Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to established dimensions.
- C. Maintain temperature of between 64 degrees Fahrenheit and 75 degrees Fahrenheit and between 30 and 55 percent humidity in areas of active electronic system work.

### 1.4 REFERENCES

- A. The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only.
- B. 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 two weeks prior to the date of the Bidding Documents unless the document is shown dated.

C. 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.

D. References.

1. ANSI/TIA/EIA-568-D, Commercial Building Telecommunications Wiring Standards
2. ANSI/TIA/EIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces
3. ANSI/TIA/EIA 607-B -Commercial Building Grounding and Bonding Requirements
4. International Standards Organization/International Electromechanical Commission (ISO/IEC) DIS11801, January 6, 1994
5. Underwriters Laboratories (UL®) Cable Certification and Follow Up Program
6. National Electrical Manufacturers Association (NEMA)
7. American Society for Testing Materials (ASTM)
8. National Electric Code (NEC®) Latest Issue
9. National Electrical Safety Code (NESC) Latest Issue
10. Institute of Electrical and Electronic Engineers (IEEE)
11. UL Testing Bulletin
12. American National Standards Institute (ANSI) X3T9.5 Requirements for UTP at 100 Mbps
13. SYSTIMAX Structured Cabling Systems, Performance Specifications, Latest Issue
14. SYSTIMAX Structured Cabling Systems, Components Guide, Latest Issue
15. BICSI Telecommunications Distribution Methods Manual (TDMM) Latest Issue
16. Rural Utilities Service (RUS) Section 1755

1.5 QUALITY ASSURANCE

A. Submit written proof that the following experience requirements are being met.

1. Contractor Qualifications
  - a. The contractor shall be certified by the manufacturer of the products, adhere to the engineering, installation and testing procedures and utilize the authorized manufacturer components and distribution channels in provisioning this Project.
  - b. Must be supervised on-site by a BICSI RCDD. Must demonstrate knowledge and compliance with all BICSI, TIA/EIA, UL, and NEC methods, standards and codes.
  - c. All members of the installation team shall be certified by the manufacturer as having completed the necessary training to complete their part of the installation. Resumes of the entire team shall be provided along with documentation of completed training courses.
  - d. The contractor shall provide five references for projects of equivalent scope, type and complexity of work completed within the last five years.
  - e. The contractor who is installing the cabling infrastructure shall be a certified and currently registered Commscope/Systimax Premier Partner capable of issuing a numbered registration certificate for the entire cable system.
  - f. The contractor who is installing the cabling infrastructure shall have the following Systimax iPatch/imVision certifications:  
SP/ND3360 - SYSTIMAX SCS 360 Solutions  
SP/ND3321 - SYSTIMAX SCS Design & Engineering

SP/ND3361 - SYSTIMAX SCS Installation and Maintenance  
GL5555 - SYSTIMAX SCS Certified imVision Support Specialist  
SP/ND5500 - SYSTIMAX SCS iPATCH Design & Engineering  
SP/ND5510 - SYSTIMAX SCS Certified iPATCH Support Specialist (CISS)

- g. Cable splicing personnel shall have a minimum of five years splicing experience and shall have completed a minimum of five major splicing projects.
  2. Manufacturer's hardware experience: All components shall be produced by manufacturers who have been regularly engaged in the production of telecommunications cabling components of the types to be installed in this project for a period of five years.
- B. Materials and equipment: Equipment shall be rated for continuous operation under the ambient environmental temperature, humidity, and vibration conditions encountered at the installed location. The equipment shall meet the following requirements:
1. Interior controlled environment: 60 to 100 degrees F dry bulb and 20 to 90 percent relative humidity, non-condensing.
  2. Interior uncontrolled environment: 0 to 130 degrees F dry bulb and 10 to 95 percent relative humidity, non-condensing.
  3. Exterior environments: Minus 30 degrees to 130 degrees F dry bulb, and 10 to 100 percent relative humidity, condensing.
  4. Hazardous environment: All system components located in areas where fire or explosion hazards may exist because of flammable gas or vapors, flammable liquids, combustible dust, or ignitable fibers or flyings, shall be rated and installed according to Chapter 5 of the NFPA 70 and as shown.
- C. Standard products:
1. Equipment and materials shall be standard products of a manufacturer regularly engaged in the manufacture of telecommunications cabling products and shall be the manufacturer's latest standard design in satisfactory use for at least one year prior to bid opening.
  2. Items of the same classification shall be identical. This requirement includes equipment, modules, assemblies, parts, and components.
- D. HAS IT inspections.
1. HAS IT shall be contacted prior to cable testing to perform a cable installation inspection.
  2. Contact HAS IT no less that 3 days prior to performing certification. HAS IT

#### 1.6 CONTRACTOR'S DUTIES

- A. Contractor's RCDD shall provide all calculations and analysis to support design and engineering decisions as specified in the Submittals section.
- B. Provide and pay for all labor, supervision, tools, equipment, test equipment, tests and services/programming to provide and install a complete inside and outside plant copper infrastructure system. Pay all required sales, gross receipts, and other taxes.
- C. Secure and pay for plan check fees, permits, fees, and licenses necessary for the execution of Work as applicable for the project.
- D. Give required notices.
- E. Comply with all codes, ordinances, regulations, and other legal requirements of public authorities that bear on performance of Work.



## 1.7 PROCUREMENT

- A. Procure equipment specified in this document as dictated by the timeline in Appendix A “Technology Implementation Schedule” in order to ensure that the technology is acquired in a timely fashion, but not outdated by the installation date.
- B. Submit a copy of Appendix A “Technology Implementation Schedule” as a part of the equipment submittals required elsewhere in this document. Complete the columns headed “Quantity”, “Purchasing Lead Time”, “Start Date or Dependent”, and “Installation Duration”.
- C. The “Procurement Lead Time” shall be expressed in days or weeks, and shall include time required for the contractor’s personnel to order and receive the material. Substantiation may be required.
- D. “Start Date or Dependent” and “Installation Duration” should be an accurate estimate based upon known facts in the project. Substantiation may be required.
- E. The Contractor shall not purchase any materials requiring submittals until the owner approves the product submittal and the Technology Implementation Schedule for that material.
- F. The Contractor shall not purchase any materials requiring submittals until the date established by the owner as the Purchasing Authorized Date. The Purchasing Authorized Date will be reflected in the “Purch Auth” column of Appendix A as a part of the Submittal Review process.

## 1.8 MAINTENANCE AND SUPPORT

- A. System Assurance: The System Assurance shall cover the failure of the wiring system to support the application which it was designed to support, as well as additional application(s) introduced in the future by recognized standards or user forums that use the ANSI/TIA/EIA 568 or ISO/IEC IS 11801 component and link/channel specifications for cabling, for a twenty-year period.
- B. System Certification: Upon successful completion of the installation and subsequent inspection, the customer shall be provided with a numbered certificate, from the manufacturing company, registering the installation.
- C. Support Availability: The Contractor shall commit to make available local support for the product and system during the Warranty period.

## 1.9 EXTENDED WARRANTY

- A. The Extended Product Warranty shall meet all manufactures specification to ensure against product defects, that all approved cabling components exceed the specifications of ANSI/TIA/EIA 568 and ISO/IEC IS 11801, exceed the attenuation and NEXT requirements of ANSI/TIA/EIA 568 and ISO/IEC IS 11801 for cabling links/channels, , for a twenty year period. The warranty shall apply to all passive SCS components.
- B. The Extended Product Warranty and the System Assurance shall cover the replacement or repair of defective products and labor for the replacement or repair of such defective products.

## 1.10 DELIVERY AND STORAGE

- A. Equipment shall be delivered in original packages with labels intact and identification clearly marked.
- B. Equipment shall not be damaged in any way and shall comply with manufacturer's operating specifications.
- C. Equipment and components shall be protected from the weather, humidity, temperature variations, dirt, dust, or other contaminants. Equipment damaged prior to system acceptance shall be replaced at no cost to the City.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to SYSTIMAX SCS and other manufacturers as referenced in this document. However, substitutions for Systimax products are not permitted.

### 2.2 GENERAL

- A. Provide all cabling, terminating hardware, adapters, and cross-connecting hardware necessary to interconnect all system equipment including equipment located in the Main Distribution Facility (MDF) and the Intermediate Distribution Facilities (IDFs).

### 2.3 COPPER CABLE GENERAL REQUIREMENTS

- A. Manufacturer Qualifications: ISO 9001 Certified and included in the Underwriters Laboratories LAN Certification and Follow-up Program.

### 2.4 COPPER HORIZONTAL CABLING

- A. Manufacturer: SYSTIMAX SCS XL7– XX71.
- B. All horizontal cabling shall meet or exceed the ANSI/EIA/TIA-568 Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted Pair Cabling Components.
- C. Cables shall be marked as UL verified with a minimum of Category 6 rating.
- D. All horizontal cabling shall be color-coded as follows to differentiate between tenant and owner cabling. All voice circuits will be terminated on patch panels. All horizontal cabling will terminate on patch panels. All tenant and specialty circuits will be cross connected to multi-pair cabling as required.
  - 1. Green – HAS Data. (This applies to all HAS devices needing data cabling)
    - a. IP Cameras
    - b. Wireless Access Points(APs) – (Requires two CAT 6A data cables for 802.11ACv2)
    - c. Access Control Panels
    - d. IP Phones
    - e. Etc
  - 2. Yellow – Tenant Data

- 3. Red – Special circuits, including Automated External Defibrillation (AED) Circuits
  
- E. High performance (71 Series) Category 6 UTP, 4 Pair cabling shall be utilized to provide the signal medium from the individual workstation location to the IDF(s) unless denoted otherwise on the drawings. This cabling shall be installed in accordance with the contract drawings and shall adhere to the specifications listed below:
  - 1. 4 pair UTP
  - 2. 23 AWG Solid Bare Copper
  - 3. Cable jacket shall comply with NEC Article 800 for use as a plenum cable and shall be UL and c (UL) Listed Type CMP.
  - 4. Cable shall terminate on 8 pin modular jack at each outlet.
  
- F. The high performance Category 6 UTP cable shall be of the traditional round design with mylar separator tape between pairs 2/3 and 1/4. The cable shall support Voice, Analog Baseband Video/Audio, Fax, Modem, Switched-56, T-1, ISDN, RS-232, RS-422, RS-485, 10BASE-T Ethernet, Token Ring, 100Mbps TP-PMD, 100BASE-T Ethernet, 155 Mbps ATM, AES/EBU Digital Audio, 270 Mbps Digital Video, 622 Mbps 64-CAP ATM and emerging high-bandwidth applications, including 1 Gbps Ethernet, gigabit ATM, as well as all 77 channels (550 Mhz , single swept margin) of analog broadband video.
  
- G. The high performance Category 6 cables shall meet or exceed the electrical characteristics set by the manufactures specifications.
  
- H. The high performance Category 6 cable shall be specified to 550 MHz and shall meet the guaranteed swept margin as set by the manufacture.
  
- I. Systimax part numbers for Plenum-rated Horizontal Cabling are as follows:

Product Number	Color	COM code	Qty per Unit
2071E YEL C6 4	Yellow	700210123	W1000
2071E SGR C6 4	Green	700210164	W1000
2071E RED C6 4	Red	700210263	W1000

- A. Modular Patch Cords
  - 1. Manufacturer: Systimax SCS-GS8E
  - 2. Provide Category 6, Modular Patch Cords for each installed port designated as “Data” in the Drawings.
  - 3. All cords shall conform to the requirements of ANSI/TIA/EIA 568 Commercial Building Telecommunications Cabling Standard, Horizontal Cabling Section, and be part of the UL® LAN Certification and Follow-up Program. Cords shall be equipped with an 8 pin modular connector on each end and shall conform to the length(s) specified on the detailed drawing. All Category 6 cordage shall be round, and consist of 23-AWG copper, stranded conductors, tightly twisted into individual pairs and shall meet or exceed the electrical specifications set by the manufacture.
  - 4. UTP Patch cord lengths will be deployed as follows:

Length	Location/Application

3 ft	MDF, IDF, Computer Room, and Lab
5 ft	MDF, IDF, Computer Room, and Lab
7 ft	MDF, IDF, Computer Room, and Lab
9 ft	MDF, IDF, Computer Room, Office, Cubicle, or Lab
15 ft	Office, Cubicle, or Lab

5. Copper patch cord part numbers are as follows:

Product Number	Length	Material ID
GS8E-3ft	3FT	CPC3312-03F003
GS8E-5ft	5FT	CPC3312-03F005
GS8E-7ft	7FT	CPC3312-03F007
GS8E-9ft	9FT	CPC3312-03F009
GS8E-15ft	15FT	CPC3312-03F015

NOTE: 15 ft. UTP patch cords shall be used at the workstation only.

B. Hybrid RJ45 to 110 Patch Cords.

1. Manufacturer: Systimax 119P2PS
2. As required provide Category 6, Hybrid Patch Cords for each assigned data/voice port on the patch panel. Cords shall RJ45 connector on one end and 110GS on the other end. Cords shall be provided in appropriate lengths to accommodate all tenant voice or specialty ports as shown in detailed drawings. All Category 6 cordage shall be round, and consist of 24-AWG copper, stranded conductors, tightly twisted into individual pair and shall meet or exceed the Category 5e specifications.
3. Hybrid patch cords shall conform to the TIA 568B wiring scheme.
4. Hybrid patch cords shall be provided for each installed port designated as "Tenant Voice or Specialty jack" in the drawings.
5. Hybrid patch cord single pair part numbers are as follows(last 3 digits designates length):

Length	Material ID
8FT	CPC8662-03F-008
10FT	CPC8662-03F-010

Length	Material ID

6. Hybrid patch cord 4 pair part numbers are as follows(last 3 digits designates length):

Length	Material ID
8FT	CPC8312-03F-008
10FT	CPC8312-03F-010

C. Outlets

1. Manufacturer: Systimax
2. Systimax MGS400 Modular GigaSpeed Information Outlets - 8 position/8 conductor non-keyed modular outlets for applications up to 1 Gbps and ANSI/TIA/EIA 568 compliant for Category 6 transmission requirements and be part of the UL® LAN Certification and Follow-up Program.
3. Outlets shall meet or exceed the following electrical and mechanical specifications set by the manufacturer.
4. Standard installations shall utilize orange outlets for data. Dust Cover/Blanks shall match faceplate cover.

- 5. All IMO's (Interactive Media Outlet) shall have at a minimum 4-data ports at each location unless otherwise specified by the contract documents.
- 6. Systimax MGS400 Modular GigaSpeed Information Outlets part numbers are as follows:

Product Numbering	# per pack	Color	COM code
MGS400-112	1	Orange	700 206 683

- 7. Systimax M-Series Modular Faceplates designed for use with M-Series Modular Information Outlets:

Product Numbering	# of ports	# per pack	Color	COM code
M10L-262	1	1	White	108 258 427
M10LW-262	1 (wall)	1	White	108 258 468
M12L-262	2	1	White	108 168 469
M14L-262	4	1	White	108 168 543

- 8. Systimax M-Series Modular Surface Mount Box designed for use with one to four M-Series Modular Information Outlets. May be mounted on a flat surface with screws, Box color shall match wall/furniture surface color:

Product Numbering	# of ports	# per pack	Color	COM code
M104SMB-262	4	1	White	107 952 459
M104SMB-270	4	1	Gray	107 952 467

2.5 IDENTIFIERS, LABELS AND LABELING SYSTEM

- A. All Identification and Labeling shall follow Specification: 270553–Identification and Labeling of Communication Infrastructure. **Any deviation from the specification must be approved by HAS IT prior to installation.**

2.6 CABLE MANAGEMENT

- A. Horizontal Manager
  - 1. Manufacturer: CPI – 30130-719

2.7 SPECIAL APPLICATIONS SHIELDED TWISTED PAIR SOLUTION

- A. Shielded Cable
  - 1. CommScope Shielded Cable, F/UTP Plenum Rated Category 6A, Black Jacket, 1000ft Length

Product Numbering	# per pack	Color	COM code
2291B BK 4/23 R1000	1000ft	Black	760171025
2291B GRN 4/23 R1000		Green	760122663

- B. Shielded Outlets
  - 1. CommScope Shielded Outlet, Category 6A, F/UTP

Product Numbering	# per pack	Color	COM code
HGS620	1	Silver (F/UTP)	760152801

\* If the HGS620 information outlet is to be used at WAO, the depth of any backboxes must be increased.

C. Shielded Patch Panels

1. CommScope Shielded Panel, 1U, 24 Port, F/UTP Flat. imVision / iPatch system preinstalled, ships with 24 shielded outlets

Product Numbering	# per pack	Color	COM code
360-iP-MFTP-E-HD6B-1U-24	1	Silver	760201178

D. High Density M-Series Adapter

1. Systimax High Density M-Series Adapter - White

Product Numbering	# per pack	Color	COM code
HGS-A-MS-WHITE	1	White	760154187

E. Shielded Patch Cords

1. CommScope Shielded Patch Cords, F/UTP, Black Jacket, RJ45-RJ45, 7ft

Product Numbering	# per pack	Color	COM code
PCOSP-6AS-BK-07FT (OSP)	1	Black	CO11192-01F007
G10FP-GR-7FT		Green	CPCZZK1-01F007

**PART 3 - EXECUTION**

3.1 EXAMINATION

- A. Verify raceways, boxes, hand holes and maintenance holes are properly installed following Sections 270528, and 270543.
- B. All communication media must be installed in conduit or cable tray unless an alternate method has been approved by HAS/IT.
- C. Verify horizontal conduit is minimum 1-inch diameter.

- D. Verify backboards are properly installed.
- E. Verify telecommunications grounding system is properly installed and tested following Section 270526.
- F. Verify liquid-carrying pipes are not installed in or above any IDF/MDF that has active electronic equipment. Do not proceed with installation in affected areas until removed.

### 3.2 PREPARATION

- A. Environmental controlled communication rooms shall maintain temperature of between 64 degrees Fahrenheit and 78 degrees F and between 30 and 55 percent humidity in areas of active electronic system work.
- B. Cable Splicing: Exact cable routing, splice enclosure locations, distances, elevations, work space and purpose of splice will be governed by actual field conditions. Contractor shall perform field surveys prior to submitting layout drawings.
- C. Contractor's on-site RCDD supervisor shall review, approve and stamp all shop drawings, coordination drawings and record drawings.

### 3.3 INSTALLATION

- A. Install work following drawings, manufacturer's instructions and approved submittal data. The number of cables per run, outlet configuration and other pertinent data are included on the drawings.
- B. All installation shall be done in conformance with ANSI/TIA/EIA 568 standards, BICSI methods, Industry standards and SYSTIMAX SCS installation guidelines. The Contractor shall ensure that the maximum pulling tensions of the specified distribution cables are not exceeded and cable bends maintain the proper radius during the placement of the facilities. Failure to follow the appropriate guidelines shall require the Contractor to provide in a timely fashion the additional material and labor necessary to properly rectify the situation. This shall also apply to any and all damages sustained to the cables by the Contractor during the implementation.
- C. The SCS installation shall comply with all applicable national and local codes pertaining to low voltage cable system installations.
- D. The contractor shall adhere to the installation schedule of the general contractor and shall attend all construction meetings scheduled by the general contractor.
- E. Upon structural completion of the communications room(s) and prior to the installation of any communications equipment or supporting devices inside the room, the HAS IT Representative shall consult the Communications Designer in order to:
  - 1. Perform construction administration activities to compare as-built configuration to the design.
  - 2. Observe all "not-to-design" compliance issues and issue corrective advisement of actions.
  - 3. Upon completion of 1 and 2 above, the Communications Designer shall mark with masking tape the general layout of the equipment placement.

- F. All communications conduits shall be identified with color coded orange tape marked "Communications" every 50 feet. Tag conduit termination points (to include J-box locations) with the origination, destination and device name (if applicable) location.
- G. Vertical Cabinet Installation
1. All Cabinets shall be properly positioned, leveled, ganged, anchored, grounded and powered.
  2. All Cabinets shall be populated as noted in drawings with termination hardware, equipment, proper patch cord lengths, and power outlets.
  3. Install and anchor all vertical equipment cabinets to floor following the Drawings and manufacturer's instructions.
  4. All cabinets shall be properly ganged in each bay as shown in the Drawings.
  5. All cabinet doors shall be configured as shown in the Drawings.
  6. All cabinets shall be properly labeled per specification 270553.
  7. After final acceptance of the cabinets, coordinate with Owner to replace key/lock with silver barrel on front and back doors.
- H. The contractor shall perform all required cross connections of the horizontal cable runs to the backbone cable system. The equipment connections to the data systems shall be performed by the vendors installing and/or maintaining those systems.
- I. The contractor is responsible for providing a CD with all the cable/patch panel information in the same format that will be accepted for download in HAS's iPatch/imVision database **1 month** before any patching is completed.
- J. The contractor is responsible and must perform the following task associated with the iPatch system:
1. Connect iPatch/imVision Network Manger to designated port on HAS network switch.
  2. Inter-connect iPatch/imVision Network Manager to rack managers if applicable.
  3. Confirm that all iPatch/imVision patch panels are on line.
  4. Configure network settings for iPatch Network Manage with IP address, Mask and Gateway.
  5. Resolve patching conflicts associated with "Confirm" message on the iPatch Network Manager Display.
  6. Resolve conflicts associated with "Alarms" on iPatch/imVision Network Manager.
  7. Provide an excel file compatible with iPatch/imVision Bulk Import tool. The file will be used to build rooms, faceplates and jacks in iPatch/imVision database.
  8. Label all new devices including the iPatch/imVision Network Manager according to HAS labeling specs.
  9. Label all components according to HAS labeling specs.
  10. Provide floor plans depicting rooms lay out and outlet locations.
  11. Confirm iPatch/imVision ports are pointing toward the proper end device (iPatch/imVision to equipment or iPatch/imVision to iPatch/imVision connection).
  12. Data cabling contractor is to provide and install an iPatch/imVision 48 port copper patch panel for all new network switches/blades that are related to the project. Provide solid conductor patch cables with RJ-45 on one end and terminate the other end on the patch panel. Patch port 1 of the patch panel to port 1 on the switch until all ports on the switch are connected to the patch panel matching the port numbers.



- K. The contractor shall provide service loops (slack) for cables terminating in the IDFs. A 6-foot service loop shall be provided above the access ceiling or cable trays unless specified otherwise. This allows for future changes or expansion without installing new cables.
- L. The installation contractor shall be responsible for coordination, testing and problem resolution with the system vendors.
- M. City inspector or their designated representative shall randomly perform unannounced, on-site reviews during the installation. In addition, this person shall perform a final inspection and a complete review of the test results before the installation is accepted.
- N. Upon completion of the installation, Contractor shall prepare as-built documentation of the entire SCS. This documentation shall include:
  - 1. As-Built Drawings
    - a. All drawings shall be provided on disk in a form compatible with AutoCAD Version 14. A complete set of project plans will be provided by the Contractor on CD.
    - b. A complete diagram of all terminations in the IDFs.
    - c. A complete diagram of all copper, and inter-building cable.
    - d. Floor plans showing exact cable routings with each outlet clearly marked with cable number.
    - e. A complete diagram of all cable tray, conduits and conduit sleeves.
  - 2. Documentation
    - a. All cable inventory data documentation shall be submitted in designated as specified in specification 270553
    - b. Documentation on horizontal cable shall include cable number and length of cable.
    - c. Complete cross connect documentation is required. This information will include detailed documentation of all four pairs of each horizontal cable.
  - 3. As-built Drawings and Documentation shall be reviewed, approved and stamped by Contractor's on-site RCDD.

#### 3.4 POST-INSTALLATION TESTING AND CERTIFICATION

- A. Contractor Requirements
  - 1. Contractor shall provide sufficient skilled labor to complete testing within a reasonable test period.
  - 2. Contractor shall have a minimum of three years of experience installing and testing structured cabling systems. All installers assigned by the Contractor to the installation shall be certified by the factory to install and test the provided products.
  - 3. Contractor is responsible for supplying all of the required test equipment used to conduct acceptance tests.
  - 4. Contractor is responsible for submitting acceptance documentation as defined in 3.04.D below. No cabling installation is considered complete until test results have been completed, submitted and approved as defined in 3.04.D below.
  - 5. Contractor to insure that the database information for iPatch meets the HAS requirements.
- B. Test Procedure
  - 1. HAS IT Representative reserves the right to be present during any or all testing. Notify HAS IT Representative at least 48 hours prior to beginning test procedures.
  - 2. Testing shall be of the Permanent Link. However, Contractor shall warrant performance based on Channel performance and provide patch cords that meet channel performance.

3. All cabling not tested strictly in accordance with these procedures shall be re-tested at no additional cost to the Owner.
  4. Testing of all copper and wiring shall be performed prior to system(s) cutover.
  5. 100% of the installed cabling shall be tested. All tests shall pass acceptance criteria defined in 3.05 below.
  6. Cable testing shall be performed by a fully charged tester, and the charging unit shall be disconnected during testing.
  7. Any pairs not meeting the requirements of the standard shall be brought into compliance by the contractor at no charge to the City. Complete end-to-end test results shall be submitted to the City.
- C. Standards Compliance and Test Requirements
1. Copper Cabling shall meet the indicated performance specifications:
    - a. Category 6 Horizontal Cabling shall be tested to the manufactures specification for Category 6 Cabling and SYSTIMAX SCS GigaSpeed System.
  2. All test equipment used shall meet the performance specifications defined in 3.04.
- D. Cable Test Documentation
1. Test reports shall be submitted in hardcopy and electronic format and certified by the contractor's RCDD to be a complete and accurate record of cabling installed. Hand-written test reports are not acceptable.
  2. Hardcopy reports are to be submitted in labeled three-ring binders with an attached affidavit verifying passing execution of all tests. Hardcopy summary reports shall contain the following information on each row of the report: circuit ID, test specification used, cable length, date of test, and pass/fail result.
  3. Electronic reports shall be submitted on CD in PDF format. Electronic reports shall be accompanied by a Certificate signed by an authorized representative of the Contractor warranting the truth and accuracy of the electronic report. Certificate shall reference traceable circuit numbers that match the electronic record.
  4. Hardcopy and electronic reports for each cable route shall be submitted together in one submittal. The submittal description shall include the type of test performed, type of cable, and cable ID (including originating and terminating room numbers) of cable tested. Partial or unclear documentation will be returned without reviewing.
  5. Test reports shall include the following information for each cabling element tested:
    - a. Wiremap results that indicate that 100% of the cabling has been tested for shorts, opens, miswires, splits, polarity reversals, transpositions, presence of AC voltage and end-to-end connectivity.
    - b. For Category 6 cabling: Attenuation, NEXT, PSNEXT, Return Loss, ELFEXT, and PSELFEXT data that indicate the worst case result, the frequency at which it occurs, the limit at that point, and the margin. These tests shall be performed in a swept frequency manner from 1 MHz to highest relevant frequency, using a swept frequency interval that is consistent with TIA and ISO requirements. Information shall be provided for all pairs or pair combinations and in both directions when required by the appropriate standards. Any individual test that fails the relevant performance specification shall be marked as a FAIL. Test shall also include mutual capacitance and characteristic impedance.
    - c. Length (in feet), propagation delay, and delay skew relative to the relevant limit. Any individual test that fails the relevant performance specification shall be marked as a FAIL.
    - d. Cable manufacturer, cable model number/type, and NVP
    - e. Tester manufacturer, model, serial number, hardware version, and software version

- f. Circuit ID number and project name
  - g. Autotest specification used
  - h. Overall pass/fail indication
  - i. Date of test
6. Test reports shall be submitted within seven business days of testing.

E. Test Equipment

1. Test equipment used under this contract shall be from manufacturers that have a minimum of 5 years of experience in producing field test equipment. Manufacturers shall be ISO 9001 certified.
  - a. Category 6 – At minimum a Level III tester or submitted and owner-approved equivalent.
2. All test tools of a given type shall be from the same manufacturer, and have compatible electronic results output.
3. Test adapter cables shall be approved by the manufacturer of the test equipment. Adapters from other sources are not acceptable.
4. Baseline accuracy of the test equipment shall exceed TIA Level III, as indicated by independent laboratory testing.
5. Test equipment shall be capable of certifying Category 6 links.
6. Test equipment shall have a dynamic range of at least 100 dB to minimize measurement uncertainty.
7. Test equipment shall be capable of storing full frequency sweep data for all tests and printing color graphical reports for all swept measurements.
8. Test equipment shall include S-Band time domain diagnostics for NEXT and return loss (TDNXT and TDRL) for accurate and efficient troubleshooting.
9. Test equipment shall be capable of running individual NEXT, return loss, etc measurements in addition to autotests. Individual tests increase productivity when diagnosing faults.
10. Test equipment shall include a library of cable types, sorted by major manufacturer.
11. Test equipment shall store at least 250 Category 6 autotests (in full graphic format) in internal memory, with the option for additional storage card via expansion slot.
12. Test equipment shall be able to internally group autotests and cables in project folders for good records management.
13. Test equipment shall include DSP technology for support of advanced measurements.
14. Test equipment shall make swept frequency measurements in compliance with TIA standards.
15. The measurement reference plane of the test equipment shall start immediately at the output of the test equipment interface connector. There shall not be a time domain dead zone of any distance that excludes any part of the link from the measurement.

3.5 ACCEPTANCE

- A. Once all work has been completed, test documentation has been submitted and approved, and HAS IT Representative is satisfied that all work is in accordance with contract documents, the HAS IT Representative will notify Contractor in writing of formal acceptance of the system.
- B. Acceptance Requirements
  1. Contractor's RCDD shall warrant in writing that 100% of the installation meets the requirements specified under 3.04. "Standards Compliance & Test Requirements" above.
  2. HAS IT Representative reserves the right to conduct, using Contractor equipment and labor, a random re-test of up to five percent of the cable plant to confirm documented

- results. Random re-testing, if performed, shall be at the expense of the City, using standard labor rates. Any failing cabling shall be re-tested and restored to a passing condition at no cost to the City. In the event more than two percent of the cable plant fails during re-test, the entire cable plant shall be re-tested and restored to a passing condition at no additional cost to the Owner.
3. HAS IT Representative may agree to allow certain cabling runs to exceed standardized performance criteria (e.g. length). In this event, such runs shall be explicitly identified and excluded from requirements to pass standardized tests.
  4. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating, and submittal and approval of full documentation as described in 3.04.
  5. See Appendix A & B. Acceptance requirements are not limited to these sheets

### 3.6 DEMOLITION

- A. The contractor shall be responsible for maintaining all communications service to areas of the building scheduled to remain in service during the period of renovation.
- B. Notify HAS Information Technology (IT) department 30 days prior to the start of demolition work taking place in existing communications rooms. Coordinate removal of equipment and cabling within existing communications rooms with HAS IT.
- C. Where removal is indicated in Drawings, remove communications cable from termination point back to originating communications room, MDF or tenant communications room. Coordinate removal at terminating blocks and panels with HAS IT. Coordinate removal of cross-connects and patch cables with HAS IT.
- D. Ensure systems and circuits are no longer active before removing and prior to the demolition of existing communications rooms. If active circuits exist at time of scheduled demolition, coordinate with HAS IT Representative to reroute or deactivate circuit(s).
- E. Demolition and removal of cabling shall not impact the operation of active systems.
- F. Unless otherwise noted, discard all removed cable, patch cables and cross-connects. Except where re-routing of cable is specified in Drawings or by Designer, do not reuse cable.
- G. Remove all loose unterminated cabling to source found above ceiling, under floor or in wall.
- H. Demo all abandoned cable in accordance with NEC 800.25.

### 3.7 CLEANING

- A. Remove all unnecessary tools and equipment, unused materials, packing materials, and debris from each area where Work has been completed unless designated for storage.

END OF SECTION

APPENDIX A  
MDF/IDF Check List

This list is intended as a minimum checklist. CM should ensure that the contractor's schedule has built in these components and the necessary buffer period – and associated access restrictions to the communications equipment rooms -- for HAS IT and tenant IT to prepare.

1. All communication rooms that will service the area to be opened must be completed. That means a final walkthrough of these areas has been completed. It is not necessary that the entire project achieve substantial completion, but IT cannot install equipment and begin work until the following minimum criteria is met:
  - a. Space is built out and clean – free from dust/residues.
  - b. Electrical w/UPS as required.
  - c. All racks/cabinets installed and mounted. Padlocks eyes have been installed.
  - d. Grounding bus bar installed and properly tied to main grounding bus bar in MDF
  - e. HVAC functioning properly and is adequately filtering dust. Humidity is controlled.
  - f. Door access control is installed (card reader) -or- an approved temporary provision. Simple key access is not permissible.
  - g. Lighting is installed and operational.
  - h. Cable trays/ladder racks installed and ready to use.
  - i. Permanent or temporary signage identifying permanent room number.

2. All cabling necessary to operate the areas to be opened is completed.
  - a. Backbone cabling (copper and fiber) from the applicable communication room(s) is installed, tested, labeled, and approved by the inspector and communications design consultant.
  - b. Horizontal cabling for all areas to be occupied is installed, tested, labeled, and approved by the inspector and communications design consultant.
  - c. Copper cross connects and/or fiber jumpers have been installed per the owner/tenant requirements.
  - d. Cable records and redline drawings for installed cables are submitted and approved PRIOR to putting any active circuits on the new cables. Cable records reflect all installed cables \*\*and\*\* any cross connects or jumper assignments installed by the contractor.
  - e. All iPatch Panels are programmed and operational.
  - f. All jumpers and patch cords specified by the contract are transmitted to the owner for use.
  - g. NOTE: cable labels and permanent room numbers need to match. CM needs to be sure to get design team, airport, IT, and CM / contractor reps together to review permanent room numbers prior to contractor installing cable labels.

3. Move-in buffer period needs to be minimum **6 weeks** for HAS-IT to install/extend services within the area to be occupied prior to occupation of the facility or spaces. Additional time may be necessary if Tenant IT organization is involved, or if contractor has other systems that must be configured/tested which require HAS-IT resources (i.e. cabling or data network connections). This is frequently the case for PA System, television, radio, Fire Alarm, pay telephone, EFSO (Electronic Fuel Shutoff), access control & CCTV, etc.

4. Once HAS-IT accepts a communications equipment room and begins to install/configure equipment in preparation for hosting live applications, this room becomes a restricted area with access to be controlled by HAS-IT. Contractors must be substantially complete with systems inside the communications equipment room so that access is generally not required. Minor punch list and scheduled testing with escort can be arranged, but access will be very limited.

5. Other IT-related systems that must be operational, tested, and accepted or approved temporary provisions.

- a. PA System
- b. MATV and/or CNN TV (where applicable)
- c. Fire Alarm
- d. MUFIDS
- e. Pay Telephones (where applicable)
- f. EFSO (where applicable)
- g. Access Control & CCTV (note: must be PROGRAMMED, and approved acceptance test walk through by HAS)
- h. Crash phone (where applicable)
- i. Radio system enhancements (where applicable)
- j. Data Network switch installed and configured.

APPENDIX B

IDF Number:		Date:		
Grounding & Bonding:		YES	NO	COMMENTS
	TGB properly installed			
	Proper grounding conductor installed (6AWG min.)			
	Cable trays properly bonded			
	Equipment Racks, Armored Cables & Cabinets properly bonded			
	Conduit properly bonded			
	Cabling properly bonded			
	Splice Cases properly bonded			
Horizontal Cabling:		YES	NO	COMMENTS
	Routing			
	Cables properly supported			
	Pull tensions properly recorded			
	Sheath damage			
	Bend radius observed			
	Pair twist meets spec			
	Proper termination scheme			
	Cable/jack part number meets spec			
	Plenum vs. PVC			
	Properly dressed in tray			
	Properly dressed in cable management			
	Cables bundled properly			

	<b>Appropriate clearances observed (power)</b>			
	<b>Minimum amount of cable exposed at termination</b>			
<b>Backbone Cabling:</b>		<b>YES</b>	<b>NO</b>	<b>COMMENTS</b>
	<b>Fiber strain relief properly applied</b>			
	<b>Routing</b>			
	<b>Cables properly supported</b>			
	<b>Pull tensions properly recorded</b>			
	<b>Sheath damage</b>			
	<b>Bend radius observed</b>			
	<b>Properly dressed in tray</b>			
	<b>Fiber installed in inner duct</b>			
	<b>Properly dressed in termination shelf</b>			
	<b>Any splice cases properly supported</b>			
<b>Room Layout:</b>		<b>YES</b>	<b>NO</b>	<b>COMMENTS</b>
	<b>Room laid out according to project drawings</b>			
	<b>Proper clearances maintained</b>			
	<b>Is the room clean &amp; neat in appearance</b>			
	<b>Liquid carrying pipes within the room</b>			
<b>Pathways:</b>		<b>YES</b>	<b>NO</b>	<b>COMMENTS</b>
	<b>Conduit properly routed &amp; supported</b>			
	<b>Cable Tray properly routed &amp; supported</b>			
	<b>Inner Duct used to route fiber and properly supported</b>			
<b>Labeling:</b>		<b>YES</b>	<b>NO</b>	<b>COMMENTS</b>
	<b>Grounding conductor</b>			
	<b>End-to-End labeling</b>			
	<b>Pair Count on Splice Case</b>			



	<b>Horizontal Cabling</b>			
	<b>Fiber Optic Cabling</b>			
<b>Other:</b>		<b>YES</b>	<b>NO</b>	<b>COMMENTS</b>
	<b>Appropriate fire stop material in place</b>			
	<b>Cabling test results submitted with proper information</b>			
	<b>Climate controlled environment (Temp. &amp; Humidity)</b>			
	<b>Is the room access controlled</b>			
<b>Copper Cabling:</b>				
	<b>Total Pairs (Riser)</b>			
	<b>Pair Counts</b>			
	<b>Termination Type (66, 110, Protectors..)</b>			
	<b>Termination Location</b>			
<b>Fiber Optic Cabling:</b>				
<b>Multimode:</b>				
	<b>Total Strands</b>			
	<b>Termination Type (LC, SC)</b>			
	<b>Termination Location</b>			
<b>Single Mode:</b>				
	<b>Total Strands</b>			
	<b>Termination Type (LC, SC)</b>			
	<b>Termination Location</b>			

End Of Appendix

SECTION 272100  
DATA COMMUNICATION NETWORK EQUIPMENT  
(REV. 01-14-2020-TAB)

PART 1 - GENERAL

1.01 SUMMARY

- A. Passenger loading bridge replacement.
- B. Provide the Local Area Network (LAN) active components and interfaces to be implemented and utilized in the Houston Airport System network to support present and future communications systems requirements.
- C. Provide HAS wireless connectivity for all new construction and/or remodel.

1.02 REFERENCES

- A. The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only.
- B. 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.
- C. Related Work:
  - 1. Section 270553: Identification and Labeling of Communication Infrastructure
  - 2. Section 271500: Horizontal Media Infrastructure
  - 3. Section 270543: Exterior Communication Pathways
  - 4. Section 270526: Telecommunications Grounding and Bonding
- D. 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.
- E. References:
  - 1. National Electrical Manufacturers Association (NEMA)
  - 2. American Society for Testing Materials (ASTM)
  - 3. National Electric Code (NEC)
  - 4. Institute of Electrical and Electronic Engineers (IEEE)
  - 5. UL Testing Bulletin
  - 6. American National Standards Institute (ANSI) X3T9.5 Requirements for UTP at 100 Mbps

1.03 DEFINITIONS

- A. *ANSI* – American National Standards Institute

- B. *ATM* – Asynchronous Transfer Mode
  - C. *EIA* – Electronics Industries Alliance
  - D. *Gbps* – Gigabits per second
  - E. *IEEE* – Institute of Electrical and Electronic Engineers
  - F. *ISO* – International Organization for Standardization
  - G. *Mbps* – Megabits Per Second
  - H. *MIMO* – Multiple-In and Multiple-Out
  - I. *Multi-path* – The possible multiple routes of a single source of RF energy due to reflection, refraction, or diffraction.
  - J. *NEC* – National Electrical Code
  - K. *NEMA* – National Electrical Manufacturing Association
  - L. *RF* (Radio Frequency) – Signal generated by a radio transmitter and sent out through an antenna. The frequency of the transmission is described in terms of the number of cycles per second or Hertz (Hz).
  - M. *SFP* – Small Form-Factor Pluggable – Hot-pluggable transceiver used for both telecommunication and data communication applications. Comes in both copper and fiber.
  - N. *SNMP* – Simple Network Management Protocol
  - O. *TIA* – Telecommunications Industry Association
  - P. *TR* – Telecommunications Room
  - Q. *UL* – Underwriter’s Laboratories
  - R. *VoIP* – Voice over Internet Protocol
  - S. *WAP* – Wireless Application Protocol
  - T. *WPA/WPA2* – WiFi Protected Access / WiFi Protected Access II – IEEE 802.11i-2004
- 1.04 DESIGN AND PERFORMANCE STANDARDS
- A. Standards supported should include, but be not limited to, IEEE 802.3, 10BASET, IEEE 802.3u, 100BaseTX, 1000BaseFX, IEEE 802.11, IEEE 802.3ae-2002, Ethernet MIB (RFC 1643), SNMP MIB II (RFC 1213).
  - B. All designs must adhere to HAS Cyber Security Standards.
- 1.05 SUBMITTALS

- A. Qualifications: Demonstrate compliance with requirements of Paragraph 1.07.A.
- B. Submit Technical Implementation Plan in accordance with 2.06.
- C. Submit manufacturer's technical data for each product provided.
- D. Submit technical and operations manuals. Manuals shall describe function, operation, and programmable parameters for each card and port for each device to be installed. Manuals shall include required maintenance to be performed.
  - 1. Manuals shall describe function, operation, and programmable parameters for each card and port for each device to be installed. Manuals shall include required maintenance to be performed.
  - 2. Manuals shall be suitable for the training of future personnel by the City, and for use as a reference by currently employed personnel in performing work assignments.
- E. As-built documentation. Notes shall be kept during initial installation and shall be made a permanent part of the installation manual pages as required.
- F. For each active device installed, provide a printed configuration including a printout of the device as displayed on the network management system. Printed configuration parameters for each port on the device shall accompany the written report.
- G. Other information in support of the design, fabrication, and installation of the LAN system.
- H. An implementation schedule listing dates for LAN equipment installations for approval by the City Engineer. The dates of LAN equipment installations shall be in accordance with dates for installation of the various special systems and users. It is incumbent upon the LAN implementers to include the dates for special system and user installs into the schedule.
- I. Include spares list to be approved by HAS IT Project Manager for approval.

#### 1.06 CONTRACTOR'S DUTIES

- A. Perform all work, coordination, systems integration, engineering design, and testing, and shall provide all products required in order to ensure a fully operative system and proper installation of equipment. System operability and proper installation shall be verified via completion of the acceptance test plan.
- B. Coordinate all installation activities and details with the Houston Airport Systems' Information Technology (HAS IT) Representative. The HAS IT Representative shall be responsible for approving the final configuration of all equipment supplied as part of this specification.
- C. Provide all system documentation and submittals.
- D. Provide warranty and maintenance support as specified.
- E. Provide all calculations and/or analysis to support design and engineering decisions as specified in Submittals.

- F. Provide and pay for all labor, materials, and equipment. Pay required sales, gross receipts, and other taxes.
- G. Secure and pay for plan check fees, permits, fees, and licenses necessary for execution of Work as applicable for the project.
- H. Give required notices.
- I. Comply with all codes, ordinances, regulations, and other legal requirements of public authorities that bear on performance of Work.

#### 1.07 QUALITY ASSURANCE

- A. Contractor Qualifications:
  - 1. The contractor must be certified by the manufacturer of the products to be installed adhere to the engineering, installation and testing procedures, and utilize the authorized manufacturer components and distribution channels in provisioning this Project.
  - 2. All members of the installation team must be certified by the manufacturer(s) as having completed the necessary training to complete their part of the installation.
  - 3. Contractor shall provide five references for projects of approved equivalent scope, type and complexity of work completed within the last five years.
- B. Equipment and materials supplied for the LAN shall be a standard product of manufacturers regularly engaged in the manufacture and installation of information backbone technologies and shall be the manufacturer's latest standard design. Items of the same classification shall be identical. This requirement includes equipment, modules, assemblies, parts, and components. Electrically powered equipment shall be UL approved. Electronic equipment shall meet the requirements of the FCC (Federal Communications Commission) Title CFR 47 Part 15.
- C. All hardware, software, firmware, and/or operating system requirements given are the minimum requirements. The Contractor's product shall meet or exceed these requirements. The product selected shall meet the operational, functional, and performance requirements specified herein. Additionally, due to the rapid advancement and antiquation of technology related products, the supplied product shall be the "contemporary technical equivalent" of that specified. "Contemporary technical equivalent" shall be based on a comparison of technology at the time of publication of specification to the technology at the time of the first product submittal. Final product approval is at the sole discretion of the City.

#### 1.08 MAINTENANCE AND SUPPORT

- A. Provide the manufacturer's standard maintenance and support services for all hardware and software associated with this system at no additional charge for a period of not less than three years. It will be the responsibility of the HAS IT Representative to provide the operational maintenance and support of the installed system. Coordination through the City Engineer and the HAS IT Representative shall be required by the installation contractor to ensure that all documentation for the manufacturer's maintenance and support programs are in place.

- B. All lead technicians performing installation shall have a minimum of two years experience on the proposed system and be manufacturer certified on all hardware/software applications.

#### 1.09 EXTENDED WARRANTY

- A. Provide the manufacturer's warranty for all equipment installed at no additional charge for a period of not less than three years. The warranty shall ensure that the installed equipment will conform to its description and any applicable specifications, and shall be of good quality for the known purpose for which it is intended. The warranty shall allow for replacement or repair at the discretion of the City Engineer and shall include all upgrades for firmware and/or operating systems.
- B. Software License
  - 1. Required software licenses shall be identified and supplied by the Contractor. Licenses shall be "Site Licenses" which shall cover all equipment installed now or in the future.
  - 2. All software licenses and warranties shall be registered in the name of Houston Airport System.

#### 1.10 PROCUREMENT

- A. Procure equipment specified in this document as dictated by the timeline in Appendix B in order to make sure that the technology is acquired in a timely fashion, but not outdated by the installation date.
- B. Submit a copy of Appendix B "Technology Implementation Schedule" as a part of the equipment submittals required elsewhere in this document. The Contractor shall complete the columns headed "Quantity", "Procurement Lead Time", "Start Date or Dependent", and "Installation Duration".
- C. The "Procurement Lead Time" shall be expressed in days or weeks, and shall include time required for the contractor's personnel to order and receive the material. Substantiation may be required.
- D. "Start Date or Dependent" and "Installation Duration" should be an accurate estimate based upon known facts in the project. Substantiation may be required.
- E. The Contractor shall not purchase any materials requiring submittals until the City Engineer approves the submittal for that material and the Technology Implementation Schedule.
- F. The Contractor shall not purchase any materials requiring submittals until the date established by the City Engineer as the Purchasing Authorized Date. The Purchasing Authorized Date will be reflected in the "Purch Auth" column of Appendix B as a part of the Submittal Review process.

### PART 2 - PRODUCTS

#### 2.01 EQUIPMENT MANUFACTURERS

- A. LAN Equipment: Unless otherwise specified, furnish products manufactured by Cisco Systems. Substitutions for specified Cisco Systems components are NOT permitted.
- B. Uninterruptible Power Supply (UPS): Eaton or submitted and approved equivalent.
- C. Workstations: Reference Specification 272200 – PC, Laptop and Server Equipment.
- D. Network Printers: Reference Specification 272200 - PC, Laptop and Server Equipment.
- E. Wireless Access Point: Aruba or submitted and approved equivalent.
- F. Wireless Access Point Enclosure: American Access Technologies, Inc. or submitted and approved equivalent.
- G. For cabinets/racks and cabling infrastructure: Reference Specification 271100 – Cabinets and Equipment Rooms.
- H. Courtesy Phone: CEECO or submitted and approved equivalent.
- I. Cat 6 Media extenders Veracity Global or submitted and approved equivalent.

## 2.02 GENERAL LAN REQUIREMENTS

- A. The LAN configuration shall be a hierarchical star utilizing centralized core switches that star out to individual edge level devices located throughout the premises in designated areas. Single Mode Fiber Optic Cable (provided in Section 271300) provides the connectivity between all devices. Each edge level device services the HAS communications equipment (Administrative LAN workstations, building management stations, etc.) via UTP Copper Cabling.
- B. All LAN equipment shall provide Internet Protocol (IP) switching across all types of network technologies and topologies, including Ethernet, Fast Ethernet and Gigabit Ethernet.
- C. The LAN architecture shall be based on 10 Gbps between the two core networking switches located in the MDF and the edge level networking equipment located in the TR. In addition, the edge level equipment shall be dual homed to the separate core devices where applicable.
- D. Each active device shall be accessible from a network, console or auxiliary RS-232 port. A configuration specialist shall be able to enter supervisory mode and change default configurations as appropriate for required operation of special system components.
- E. Each active device shall be capable of generating Simple Network Management Protocol (SNMP) or SNMP3 alarms. The device shall be respondent to RMON inquiries from an expert level network management inquirer.
- F. All network equipment shall be compliant to physical and operational parameters. The equipment shall be capable of responding to SNMP, SNMP3 and/or RMON network management program calls from the Network Management System.

- G. Network equipment shall provide multimedia and multicast support through use of Protocol Independent Multicast (PIM), Internet Group Management Protocol (IGMP).
- H. Network equipment shall support full-duplex connectivity on links (10Base-TX, 100Base-TX, 1000Base-TX, 100Base-F/TX, and 1000Base-FX).
- I. All fiber interfaces on network switches must support Digital Optical Monitoring (DOM) feature.
- J. All network equipment shall be Virtual Local Area Network (VLAN) compatible based on both port and MAC addresses. VLAN assignments shall be configurable from a centralized administrative console.
- K. Network equipment shall not require re-configuration of end-station network interface cards or network interface card drivers to accommodate intra-VLAN and inter-VLAN traffic.
- L. Network equipment shall support automated VLAN creation and administration capabilities.
- M. Network equipment shall support port mirroring. This shall be done by sending frames directly from a specified port to another switch port or from an external network analyzer.
- N. Network equipment for use in the main MDF and TRs shall belong to one family of product. The equipment must allow for common sparing of all Interface Processor Modules and all Supervisor Modules.
- O. Network equipment shall support Terminal Access Controller Access Control System (TACACS), in order to provide secure port filtering. The equipment must enable individual ports to allow access only to certain workstations.
- P. All active LAN devices shall include all software as required for interconnectivity. All active devices shall have fully functional network management options installed.

## 2.03 LAN HARDWARE REQUIREMENTS

- A. All equipment shall be rack mountable in standard 19-inch racks. Contractor is responsible for providing fans, shelves, drawers, special power wiring, ground connections, and adapters of any kind necessary to accommodate the system installation, operation, testing, or maintenance. Contractor shall provide the appropriate factory or custom rack mount adapters for all equipment installed in the equipment rack, whether specifically itemized or not. Contractor shall cover unused slots using blank panels.
- B. Fiber and Copper Patch Cords – Adequately sized fiber and copper patch cords shall be provided for each installed port in the LAN under Section 271500, “Horizontal Media Infrastructure.”
- C. Core Networking Equipment
  - 1. The core layer networking equipment shall be located in the MDF as shown in the contract drawings.
  - 2. The chassis shall accommodate a minimum of nine (9) interface modules and



provide connectivity to mixed network topologies. The use of a chassis is to support networking topologies without the use of external bridges or routers. The chassis shall have redundant power supplies, in the form of hot-swappable modules which can equally share the chassis power load. If one power supply fails the system shall notify the network manager and also provide a display on the front of the chassis. The chassis shall support quality of service through support of IP Precedence, Resource Reservation Protocol (RSVP), and 802.1p.

3. The switch backplane shall provide a minimum of 1440 Gbps switching fabric on the network bus.
  4. The chassis shall include modules with a minimum of 24 Gigabit Ethernet (single mode fiber) ports to be connected to distribution layer switches in the Terminal MDFs.
  5. The chassis shall support:
    - a. Redundant supervisor modules.
    - b. Hot swappable line cards.
    - c. Layer 2 and Layer 3 IP switching.
    - d. Up to 240 10/100/1000 Ethernet ports.
    - e. Support broadcast suppression.
    - f. Support IGMP snooping and pruning.
  6. The core switching equipment shall, at a minimum, a Cisco Catalyst 6509 with the following modules:
    - a. Two Supervisor 1440 modules with integrated fabric, Multilayer Switching Feature Card 4 (MSFC4) and Policy Feature Card 4 (PFC4).
    - b. Fabric-enabled Gigabit Ethernet module(s) with enough SFP ports to support the connectivity requirements for core to core and core to distribution switch uplinks. All SFP ports shall include Long Wavelength / Long Haul (1000Base LX/LH) SFPs (single-mode).
    - c. Fabric-enabled, inline power 48-port 10/100/1000Base TX module(s) to provide connectivity for the Layer 3 switch ports
    - d. Network Analysis Module.
    - e. Intrusion Detection Module.
    - f. Firewall Services Module.
    - g. Two 6000W AC power supplies.
- D. Edge Level Equipment
1. The edge level networking equipment shall be located in the individual TR as shown in the contract drawings unless noted otherwise.
  2. The devices shall provide a minimum of 10 Gbps switching fabric.
  3. The device shall include a module(s) with the appropriate RJ45 Category 6 UTP 10/100/1000BaseTX ports to support the port requirements shown on the contract drawings. In addition, the device shall have the capability to "stack" with additional devices to increase the available port count.
  4. The edge level devices shall have the capability to simultaneously accommodate a minimum of two Gigabit Ethernet uplinks and 24 10/100/1000 VoIP Ethernet ports.
  5. The devices shall support the bonding and trunking of Fast Ethernet and Gigabit Ethernet ports.

6. The edge level switching equipment shall be Cisco Catalyst C9300-24U-E or submitted and owner-approved equivalent. Use 24 port switch if 16 ports or less are active. Upgrade to the 48 port switch (C9300-48U-E) if more than 16 ports are active. Switches must also come with network module C9300-NM-4G (4 x 1gb), single-mode SFPs, and three year term license (C9300DNA-E-24-3Y for 24 port and C930DNA-E-48-3Y for 48 port). Switches are to be ordered with the following power supply - PWR-C1-1100WAC – 1100W AC power supply.
7. The edge level equipment for industrial environment applications shall be Cisco IE-3200-8P2S-E or submitted and owner-approved equivalent. The switch supports 8 POE/POE+ copper connections and 2 SFP ports for uplinks. Power supply to be provided is PWR-IE170W-PC-AC=.

#### 2.04 UPS HARDWARE REQUIREMENTS

- A. If a room wide UPS is not installed provide a rack-mounted UPS in equipment cabinet in the Telecommunications Room that houses LAN equipment. The UPS shall have an output capacity of 5KVA (3750 Watts). All remaining TRs shall be supported by a UPS as well. Unit must have enough batteries to keep all equipment attached to the unit running for minimum of one (1) hour. If specified UPS cannot be installed due to space restraints a smaller UPS (Eaton 5PX1500RTN) can be substituted if submitted and owner-approved prior to installation, runtime requirements and environmental probe are still required.
- B. The UPS interface port shall have an RS-232 communications port and a 10/100 Base-T Ethernet for LAN management. Include optional environmental probe (Eaton part # 42R4317).
- C. The control panel shall have a LED status display for load and battery bar-graphs in addition to replace battery and overload indicators.
- D. The Output Connections shall include as a minimum one NEMA L6-30R, two NEMA L6-20R, and eighteen NEMA 5-15R.
- E. Input connection shall be nominal 208 V via L6-30P plug.
- F. Include software and interface card to provide Web/SNMP management through 10/100Base-T Ethernet port. Management software shall include the following attributes:
  1. Shall allow complete configuration of the UPS devices from a remote location
  2. Shall provide periodic UPS self-tests
  3. Shall provide full control over UPS transfer settings
  4. Shall provide user name and password security
  5. Shall log all power events with a description
- G. UPS shall be Eaton 9PX5KTF5 5000VA RM 5U 208V series with Web / SNMP Management Card for Ethernet and optional environmental probe, or submitted and owner-approved equivalent.

#### 2.05 WIRELESS ACCESS POINT

- A. General: One 802.11acv2 Wireless Access Point shall be installed per the Drawings.
- B. INDOOR Access Points
  - 1. AP-330 series specifications
    - a. AP-335 and IAP-335
    - b. 2.4- GHz (600 Mbps max) and 5-GHz (1.733 Gbps max) radios, each with 3x3 MIMO and three integrated omni-directional downtilt antennas.
  - 2. AP-334 and IAP-334
    - a. 2.4-GHz (600 Mbps max) and 5-GHz (1.733 Gbps max) radios, each with 3x3 MIMO and three combined, duplexed external antenna connectors.
- C. Wireless radio specifications
  - 1. AP type: Indoor, dual radio, 5 GHz 802.11acv2 and 2.4 GHz 802.11n
    - a. In addition to 802.11n data rates, the 2.4-GHz radio supports 802.11acv2 data rates using 256-QAM modulation. This gives TurboQAM-enabled clients a 33% boost above the maximum supported data rate.
  - 2. Software-configurable dual radio supports 5 GHz and 2.4 GHz
  - 3. 4x4 MIMO with three spatial streams and up to 1.733 Gbps wireless data rate
  - 4. Supported frequency bands:
    - a. 2.4000 GHz to 2.4835 GHz
    - b. 5.150 GHz to 5.250 GHz
    - c. 5.250 GHz to 5.350 GHz
    - d. 5.470 GHz to 5.725 GHz
    - e. 5.725 GHz to 5.850 GHz
  - 5. Available channels: Dependent upon configured regulatory domain
  - 6. Dynamic frequency selection (DFS) optimizes the use of available RF spectrum
  - 7. Supported radio technologies:
    - a. 802.11b: Direct-sequence spread-spectrum (DSSS)
    - b. 802.11a/g/n/ac: Orthogonal frequency-division multiplexing (OFDM)
    - c. 802.11n/acv2: 4x4 MIMO with up to three spatial streams
  - 8. Supported modulation types:
    - a. 802.11b: BPSK, QPSK, CCK
    - b. 802.11a/g/n: BPSK, QPSK, 16-QAM, 64-QAM
    - c. 802.11ac: BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM
  - 9. Transmit power: Configurable in increments of 0.5 dBm
  - 10. Maximum (aggregate, conducted total) transmit power (limited by local regulatory requirements):
    - a. 2.4-GHz band: +23 dBm (18 dBm per chain)
    - b. 5-GHz bands: +23 dBm (18 dBm per chain)
  - 11. Advanced cellular coexistence (ACC) feature to effectively deal with interference from cellular systems
  - 12. Maximum ratio combining (MRC) for improved receiver performance
  - 13. Cyclic delay diversity (CDD) for improved downlink RF performance
  - 14. Short guard interval for 20-MHz, 40-MHz and 80-MHz channels
  - 15. Space-time block coding (STBC) for increased range and improved reception

16. Low-density parity check (LDPC) for high-efficiency error correction and increased throughput
17. Transmit beam-forming (TxBF) for increased reliability in signal delivery
18. Supported data rates (Mbps):
  - a. 802.11b: 1, 2, 5.5, 11
  - b. 802.11a/g: 6, 9, 12, 18, 24, 36, 48, 54
  - c. 802.11n: 6.5 to 450 (MCS0 to MCS23)
  - d. 802.11ac: 6.5 to 1,300 (MCS0 to MCS9, NSS = 1 to 3)
19. 802.11n high-throughput (HT) support: HT 20/40
20. 802.11acv2 very high throughput (VHT) support: VHT 20/40/80/160
21. 802.11n/acv2 packet aggregation: A-MPDU, A-MSDU

#### D. Power

1. Maximum power consumption: 25.3 watts, plus up to 5.9 watts for attached USB device and internal overhead.
2. Power sources sold separately
3. Direct DC source: 12 Vdc nominal, +/- 5%
4. Power over Ethernet (PoE): 48 Vdc (nominal) 802.3af or 802.3at-compliant source
  - a. Efficient mode PoE – power save with 802.3af PoE and limited functionality
    - 1) USB port disabled
    - 2) Second Ethernet port disabled
    - 3) 2.4-GHz 802.11n radio in 1x3:1 spatial-stream mode
    - 4) 5-GHz 802.11ac radio operates without restrictions\*
  - b. Unrestricted functionality with 802.3at PoE+
5. \*With ArubaOS software 6.3.0, the 5-GHz 802.11ac radio operates in 2x3:2 spatial stream mode when the AP is powered by 802.3af PoE. This restriction has been removed in 6.3.1.

#### E. Antennas

1. AP-334: Four RP-SMA connectors for external dual-band antennas. Internal loss between radio interface and external antenna connectors (due to diplexing circuitry): 1.5 dB in 2.4 GHz and 3.0 dB in 5 GHz.
2. AP-335: Eight integrated down-tilt omni-directional antennas for 4x4 MIMO with maximum antenna gain of 3.5 dBi in 2.4 GHz and 4.5 dBi in 5 GHz. Built-in antennas are optimized for horizontal ceiling mounted orientation of AP-335.

#### F. Other interfaces

1. Two 10/100/1000BASE-T Ethernet network interfaces (RJ-45)
  - a. Auto-sensing link speed and MDI/MDX
  - b. Load balancing support to achieve platform throughput greater than 1 Gbps
  - c. 802.3az Energy Efficient Ethernet (EEE)
  - d. PoE-PD: 48 Vdc 802.3af PoE or 802.3at PoE+
2. DC power interface, accepts 1.7/4.0mm center-positive circular plug with 9.5 mm length.
3. USB 2.0 port (Type A connector)
4. Serial console interface (RJ-45, TTL levels)

5. Visual indicators (LEDs):
  - a. Power/system status
  - b. Ethernet link status (2x; ENET0, ENET1)
  - c. Radio status (2x; RAD0, RAD1)
6. Bluetooth Low Energy (BLE) radio
  - a. --Up to 4 dBm transmit power (class 2) and -91 dBm receive sensitivity
  - b. --Integrated antenna with roughly 30 degrees downtilt and peak gain of 5.1 dBi (AP-334/IAP-334) or 2.2 dBi (AP-335/IAP-335)
7. Kensington security slot
8. Reset button

#### G. Mounting

1. Included with AP:
  - a. Mounting brackets (2) for attaching to 9/16-inch or 15/16-inch T-bar drop-tile ceiling
2. Optional mounting kits:
  - a. AP-220-MNT-C2: Aruba 220 series AP mount kit contains two ceiling-grid rail adapters for Interlude and Silhouette style rails.
  - b. AP-220-MNT-W1: Aruba 220 series AP mount kit contains one flat-surface wall/ceiling mount bracket.
  - c. AP-220-MNT-W2: Aruba 220 series AP mount kit contains one flat-surface wall/ceiling secure mount cradle.

#### H. Mechanical

1. Dimensions/weight (unit, excluding mount accessories):
  - a. 203 mm (W) x 203 mm (D) x 54 mm (H), 8.0" (W) x 8.0" (D) x 2.1" (H)
  - b. 750 g/27 oz
2. Dimensions/weight (shipping):
  - a. 315 mm (W) x 265 mm (D) x 100 mm (H), 12.4" (W) x 10.4" (D) x 3.9" (H)
  - b. 1,250 g/44 oz

#### I. Environmental

1. Operating:
  - a. Temperature: 0° C to +50° C (+32° F to +122° F)
  - b. Humidity: 5% to 95% non-condensing
2. Storage and transportation:
  - a. Temperature: -40° C to +70° C (-40° F to +158° F)

#### J. Regulatory

1. FCC/Industry of Canada
2. CE Marked
3. R&TTE Directive 1995/5/EC
4. Low Voltage Directive 72/23/EEC

5. EN 300 328
6. EN 301 489
7. EN 301 893
8. UL/IEC/EN 60950
9. EN 60601-1-1 and EN 60601-1-2

K. Regulatory Model Numbers

1. AP-334 and IAP-334: APIN0334
2. AP-335 and IAP-335: APIN0335

L. Certifications

1. CB Scheme Safety, cTUVus
2. UL2043 plenum rating
3. Wi-Fi Alliance certified 802.11a/b/g/n/ac

M. Warranty

1. Limited lifetime warranty

N. Minimum operating system software versions

1. ArubaOS 6.3.0.0
2. Aruba Instant 4.0.0.0

O. RF Performance Table

	Maximum transmit power (dBm) per transmit chain	Receiver sensitivity (dBm) per receive chain
<b>802.11b 2.4 GHz</b>		
1 Mbps	18.0	-92.0
2 Mbps	18.0	-92.0
5.5 Mbps	18.0	-90.0
11 Mbps	18.0	-88.0
<b>802.11g 2.4 GHz and 802.11a 5 GHz</b>		
6 Mbps	18.0	-88.0
54 Mbps	16.0	-75.0
<b>802.11n HT20 2.4 GHz and 5 GHz</b>		
MCS0/8	18.0	-88.0
MCS7/15	14.0	-71.0
<b>802.11n HT40 2.4 GHz and 5 GHz</b>		
MCS0/8	18.0	-85.0
MCS7/15	14.0	-68.0
<b>802.11ac VHT20 5 GHz</b>		
MCS0	18.0	-88.0
MCS9	12.0	-65.0
<b>802.11ac VHT40 5 GHz</b>		
MCS0	18.0	-85.0
MCS9	12.0	-62.0
<b>802.11ac VHT80 5 GHz</b>		
MCS0	18.0	-82.0
MCS9	12.0	-59.0

P.

Q. Enclosures

1. Wireless Access Points shall be installed in lockable, stainless steel Nema 4 Enclosure when mounted outdoors or in garage spaces.
2. Include back-plate, ground bus-bar, cable management, document holder, pole/wall mount adapters.
3. Provide 120VAC@15A quad receptacle with surge protection per drawings.
4. Enclosure shall be bonded to ground per NEC.

5. All conduit penetrations shall be made to prevent water ingress through the connections.
6. Enclosure size per drawings.

R. Wireless Access Point Ceiling Enclosure

1. The 802.11ac wireless access point shall be installed in a lockable enclosure mounted to the ceiling. The enclosure shall meet the following specifications:
  - a. Enclosure shall be Oberon Wireless model # 1075-WA or submitted and owner approved equivalent.
  - b. The WAP is installed in such a manner that the antennas, or face of WAP if antennas are integrated, are largely within the ABS plastic dome; there is little impact on WAP coverage with antennas largely inside dome
  - c. Back-box is 16 ga. aluminum; door and bezel are textured, white powder-coated steel; RoHS compliant
  - d. Dome is 10" x 10" x 1 1/2"; textured white ABS dome (-WA) is UL 94-5VA classified, and clear polycarbonate dome (-CP) is UL 94-5VB classified
  - e. Size: Bezel is 15" x 15", back-box is 12 3/4" x 12 3/4" x 3" deep
  - f. Knockouts for AC receptacle, (2) keystone jacks, (2) 3/4" trade conduit connector
  - g. Maximum weight to be installed inside the unit is 25 lbs.
  - h. De-rate upper operating temperature limit from +50°C to +40°C when AP in the enclosure
  - i. Enclosure must be supported by the tile bridges; when installed in the ceiling, enclosure must be supported by the building structure, independent of the suspended ceiling

2.06 OUTDOOR ACCESS POINTS

A. AP-270 series specifications

1. AP-275 and IAP-275
  - a. 2.4-GHz and 5-GHz radios, each with 3x3 MIMO and three integrated omnidirectional antennas
2. AP-274 and IAP-274
  - a. 2.4-GHz and 5-GHz radios, each with 3x3 MIMO and three combined, diplexed external antenna connectors

B. Wireless radio specifications

1. AP type: Outdoor, dual radio, 5-GHz 802.11ac and 2.4-GHz 802.11n
  - a. In addition to 802.11n data rates, the 2.4-GHz radio supports 802.11ac 256-QAM modulation. This gives TurboQAMenabled clients a 33% boost to deliver up to 600 Mbps.
2. Supported frequency bands (country-specific restrictions apply):
  - a. 2.4000 GHz to 2.4835 GHz
  - b. 5.150 GHz to 5.250 GHz
  - c. 5.250 GHz to 5.350 GHz
  - d. 5.470 GHz to 5.725 GHz
  - e. 5.725 GHz to 5.875 GHz

3. Available channels: Dependent upon configured regulatory domain
4. Dynamic frequency selection (DFS) optimizes the use of available RF spectrum
5. Supported radio technologies:
  - a. 802.11b: Direct-sequence spread-spectrum (DSSS)
  - b. 802.11a/g/n/ac: Orthogonal frequency-division multiplexing (OFDM)
  - c. 802.11n/ac: 3x3 MIMO with up to three spatial streams
6. Supported modulation types:
  - a. 802.11b: BPSK, QPSK, CCK
  - b. 802.11a/g/n: BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM (with TurboQAM clients)
  - c. 802.11ac: BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM
7. Transmit power: Configurable in increments of 0.5 dBm
8. Maximum (aggregate, conducted total) transmit power (limited by local regulatory requirements):
  - a. 2.4-GHz band: +28 dBm (23 dBm per chain)
  - b. 5-GHz bands: +28 dBm (23 dBm per chain)
9. Advanced cellular coexistence (ACC) feature to minimize interference from cellular systems
10. Maximum ratio combining (MRC) for improved receiver performance
11. Cyclic delay diversity (CDD) for improved downlink RF performance
12. Short guard interval for 20-MHz, 40-MHz and 80-MHz channels
13. Space-time block coding (STBC) for increased range and improved reception
14. Low-density parity check (LDPC) for high-efficiency error correction and increased throughput
15. Explicit transmit beam-forming (TxBF) for increased reliability in signal delivery
16. Supported data rates (Mbps):
  - a. 802.11b: 1, 2, 5.5, 11
  - b. 802.11a/g: 6, 9, 12, 18, 24, 36, 48, 54
  - c. 802.11n: 6.5 to 450 (MCS0 to MCS23, 1 to 3 spatial streams)
  - d. 802.11ac: 6.5 to 1,300 (MCS0 to MCS9, 1 to 3 spatial streams)
17. 802.11n high-throughput (HT) support: HT 20/40
18. 802.11ac very high throughput (VHT) support: VHT 20/40/80
19. 802.11n/ac packet aggregation: A-MPDU, A-MSDU Power
20. Maximum power consumption: 23 watts
21. Direct AC source: 100-240-Volt AC
22. Power over Ethernet (PoE): 48 Vdc (nominal) 802.3at-compliant source

#### C. Antennas

1. AP-274: Six N-type female connectors for external antennas
2. AP-275: Six integrated omni-directional antennas for 3x3 MIMO with maximum antenna gain of 5 dBi in 2.4 GHz and 5 dBi in 5 GHz. Built-in antennas are optimized for horizontal mounted orientation of AP-275.

#### D. Other interfaces

1. One PoE+ PD port 10/100/1000BASE-T Ethernet network interface (RJ-45)
2. One port 10/100/1000BASE-T Ethernet network interface (RJ-45)
3. AC power interface, power cords sold separately
4. Serial console interface (micro USB)
5. Reset button



6. Visual indicator (LED):
  - a. Power/system status; automatically disabled after initial operation period

E. Mounting

1. Must be ordered separately
2. Optional mounting kits:
  - a. AP-270-MNT-V1: Aruba 270 series AP long mount kit for pole/wall mounting. Reduces impact of obstruction by pole or extends away from corner.
  - b. AP-270-MNT-V2: Aruba 270 series AP short mount kit for pole/wall mounting

F. Mechanical AP-274

1. Dimensions/weight (excluding mount):
  - a. 23 cm (W) x 24 cm (D) x 19 cm (H) with aesthetic cover
  - b. 9.0" (W) x 9.4" (D) x 7.5" (H)
  - c. 2.7 kg/6 lbs
  - d. 23 cm (W) x 24 cm (D) x 14 cm (H) without aesthetic cover
  - e. 9.0" (W) x 9.4" (D) x 5.5" (H)
  - f. 2.4 kg/5.3 lbs

G. Mechanical AP-275

1. Dimensions/weight (excluding mount):
  - a. 23 cm (W) x 24 cm (D) x 27 cm (H)
  - b. 9.0" (W) x 9.4" (D) x 10.6" (H)
  - c. 2.4 kg/5.3 lbs

H. Environmental

1. Operating:
  - a. Temperature: -40° C to +65° C (-40° F to +150° F)
  - b. Humidity: 5% to 95% non-condensing
2. Storage and transportation:
  - a. Temperature: -40° C to +70° C (-40° F to +158° F)
3. Operating Altitude: 3000m
4. Chassis Rating: IP66 and IP67
5. Wind Survivability: Up to 165 mph
6. Shock and Vibration: ETSI 300-19-2-4 spec T41.E 4M3

I. Regulatory

1. FCC/Industry of Canada
2. CE Marked
3. R&TTE Directive 1995/5/EC
4. Low Voltage Directive 72/23/EEC
5. EN 300 328
6. EN 301 489
7. EN 301 893
8. UL/IEC/EN 60950
9. EN 60601-1-1, EN60601-1-2

J. Regulatory Model Numbers

1. AP-274 and IAP-274: APEX0101
2. AP-275 and IAP-275: APEX0100

K. Certifications

1. CB Scheme Safety, cTUVus
2. UL2043 plenum rating
3. Wi-Fi Alliance certified 802.11a/b/g/n/ac

L. Warranty

1. Limited lifetime warranty

M. Minimum operating system software versions

1. ArubaOS 6.4
2. Aruba Instant 4.1 (planned availability mid 2014)

N. RF Performance Table

	Maximum transmit power (dBm) per transmit chain	Receiver sensitivity (dBm) per receive chain
<b>802.11b 2.4 GHz</b>		
1 Mbps	23.0	-92.0
2 Mbps	23.0	-92.0
5.5 Mbps	23.0	-90.0
11 Mbps	23.0	-88.0
<b>802.11g 2.4 GHz and 802.11a 5 GHz</b>		
6 Mbps	23.0	-88.0
54 Mbps	18.0	-75.0
<b>802.11n HT20 2.4 GHz and 5 GHz</b>		
MCS0/8	23.0	-88.0
MCS7/15	17.0	-71.0
<b>802.11n HT40 2.4 GHz and 5 GHz</b>		
MCS0/8	23.0	-85.0
MCS7/15	17.0	-68.0
<b>802.11ac VHT20 5 GHz</b>		
MCS0	23.0	-88.0
MCS9	16.0	-65.0
<b>802.11ac VHT40 5 GHz</b>		
MCS0	23.0	-85.0
MCS9	16.0	-62.0
<b>802.11ac VHT80 5 GHz</b>		
MCS0	23.0	-82.0
MCS9	16.0	-59.0

O. Enclosures

1. Wireless Access Points shall be installed in lockable, stainless steel Nema 4 Enclosure when mounted outdoors or in garage spaces.
2. Include back-plate, ground bus-bar, cable management, document holder, pole/wall mount adapters.
3. Provide 120VAC@15A quad receptacle with surge protection per drawings.
4. Enclosure shall be bonded to ground per NEC.
5. All conduit penetrations shall be made to prevent water ingress through the connections.
6. Enclosure size per drawings.

P. Lightning arrestors

1. AP-LAR-1 N-type male to N-type female in-line lightning surge arrestor (2GHz-6GHz). (AP-274 ONLY).

Q. Installation materials

1. AINS2KKIT-00 Optional Weather proofing materials: Suggested for antenna end connections only. (AP-274 ONLY).

R. RF cables for non-direct mount of antenna (optional) (AP-274 ONLY).

1. AP-CBL-1 For remoting omnis or antennas with pigtails
2. ANT-CBL-1 1m Flexible Cable
3. ANT-CBL-2 2m Flexible Cable
4. AFC7DL03-01 3m Low loss cable. AP-LAR-1 recommended
5. AFC7DL04-01 4m Low loss cable. AP-LAR-1 recommended

S. Antenna for Radio 0 (5 GHz) (AP-274 ONLY)

1. ANT-3x3-5005 MIMO, Omni, 5 dBi, 5 GHz, Direct mount to chassis or remoted with N male to N female cable (x3)
2. ANT-3x3-5010 MIMO, Omni, 10 dBi, 5 GHz, Direct mount to chassis or remoted with N male to N female cable (x3)
3. ANT-2x2-5314 MIMO, Sector 30° x 30°, 14 dBi, 5 GHz, Requires N male to N male cables (x2)
4. ANT-3x3-5712 MIMO, Sector 70° x 25°, 12 dBi, 5 GHz, Requires N male to N male cables (x3)
5. ANT-3x3-D608 MIMO, Sector 60°, 2.4/5 GHz, Requires N male to N male cables (x3)
6. ANT-3x3-D905 MIMO, Sector 90°, 2.4/5 GHz, Requires N male to N male cables (x3)

T. Antenna for Radio 1 (2.4 GHz) (AP-274 ONLY)

1. ANT-3x3-2005 MIMO, Omni, 5 dBi, 2.4 GHz, Direct mount to chassis or remoted with N male to N female cable (x3)
2. ANT-2x2-2314 MIMO, Sector 30° x 30°, 14 dBi, 2.4 GHz, Requires N male to N male cables (x2)
3. ANT-2x2-2714 MIMO, Sector 70°, 14 dBi, 2.4 GHz, Requires N male to N male cables (x2)
4. ANT-3x3-D608 MIMO, Sector 60°, 2.4/5 GHz. Requires N male to N male cables (x3)
5. ANT-3x3-D905 MIMO, Sector 90°, 2.4/5 GHz. Requires N male to N male cables (x3)

U. AP mount kit

1. AP-270-MNT-V1 Aruba 270 Series Access Point Long Mount Kit. Pole/Wall Mount for P-270 300 mm from vertical mounting asset.
2. AP-270-MNT-V2 Aruba 270 Series Access Point Short Mount Kit. Pole/Wall Mount for AP-270 75-mm from vertical mounting asset.

V. Ethernet Surge Protection Device (SPD)

1. Use in field for outdoor applications. Device shall be rated for outdoor use.
  - a. Transtector 1101-935(Gigabit POE) No exceptions.
  - b. Transtector ALPU-L130(Gigabit POE+) No exceptions.

- c. Transtector ALPU-F140(Gigabit POE++) No exceptions.

2.07 Ethernet and PoE+ Extension Unit

- A. The Enable-IT™ 828 Gigabit Ethernet and PoE+ Extension Unit.

2.08 PoE + POWER Injector

- A. Enable-IT 360 60W- 56VDC IEEE 802.3AT Gigabit PoE + Injector.

2.09 Mobility controller

- A. Aruba Networks

1. Aruba Model 7200 Series Mobility Controllers. Refer to drawings for Qty.

Model Number Aruba 7200 Controller	Number of APs Supported
7240	2048

- B. Front Panel

1. The front panel of the Aruba 7200 mobility controller contains the following components:
- a. Four 10GBase-X (SFP+) ports
  - b. Two Dual-Media Ports
  - c. LINK/ACT and Status LEDs
  - d. Management/Status LED
  - e. LCD Panel and Navigation Buttons
  - f. Console Connections - RJ-45 and Mini-USB
  - g. Expansion Slot (reserved for future use)

- C. Physical

1. Device Dimensions (without mounting brackets) (HxWxD)
- a. All Models: 1.75" x 17.5" x 17.5"
  - b. All Models: 4.4 cm x 44.5 cm x 44.5 cm
2. Device Weight (with one AC power supply installed)
- a. All Models: 16.43 lbs (7.45 kg)

- D. Power Supply Specifications

1. 350W AC Power Supply
- a. AC Input Voltage: 100 VAC to 240 VAC
  - b. AC Input Current: 5-2.5A
  - c. AC Input Frequency: 50 - 60 Hz
  - d. Weight: 2.8 lbs (1.3 kg)

- E. Operating Specifications

1. Operating Temperature Range: 0°C to 40°C (32°F to 104°F)
2. Operating Humidity Range: 5% to 95% (RH), non-condensing

F. Package Checklist

1. Inform your supplier if there are any incorrect, missing, or damaged parts. If possible, retain the carton, including the original packing materials (see Table). Use these materials to repack and return the unit to the supplier if needed.

Item	Quantity
Aruba 7200 Series Controller	1
Power Supply Unit - Installed	1
Fan Tray - Installed	1
Expansion Slot Cover - Installed	1
Blank Panel over unpopulated PSU Intake - Installed	1
Rack Mounting Brackets	2
M6 x 15mm Rack Mounting Screws	4
M4 x 6mm Rack Mount Bracket Screws	8
USB Console Cable	1
Power Cable	1
Aruba 7200 Series Installation Guide (Printed)	1
End User License Agreement (Printed)	1
Aruba Document Pointer (Printed)	1

2.010 ClearPass Policy Manager

A. ClearPass Policy Manager-5000. Refer to drawings for Qty.

1. Aruba ClearPass Policy Manager 5K hardware platform supporting a maximum of 5,000 authenticated devices.
2. Appliance Specifications:
  - a. CPU - (1) Quad Core Xeon
  - b. Memory - 8 GB
3. Hard drive storage:
  - a. (2) 3.5" SATA (7.2K RPM) 500GB hard drives, RAID-1 controller
4. Appliance Scalability:
  - a. Maximum devices - 5,000
5. Form Factor:
  - a. Dimensions (W x H x D) - 17.53" x 1.7" x 16.8"
  - b. Weight (max config) - 18 Lbs
6. Power:
  - a. Power consumption (maximum) - 250 watts max
  - b. Power supply - Single
  - c. AC input voltage - 110/220 VAC auto-selecting
  - d. AC input frequency - 50/60 Hz auto-selecting

LAN PERFORMANCE REQUIREMENTS

- B. The wired system shall perform as designed providing a minimum of 10/100/1000 Mbps to each end user device and 1Gbps from edge switch to core switch on the backbone.

## 2.011 TELEPHONE SYSTEM HARDWARE REQUIREMENTS

### A. Courtesy Telephones

1. Courtesy Telephone stations shall be class of service restricted to internal calls only, i.e. no local, collect, long distance toll (1+), toll free, (800, 888, 877, 866), operator assisted (0,0+), or directory assistance (411, 555-1212, etc.) calls shall be allowed.
2. Each Courtesy Telephone shall be capable of dialing 9+911 for an emergency and have the capacity to dial six-digit internal directory numbers (DN).
3. Each Courtesy Telephone shall transmit its DN to internal called parties.
4. Each Courtesy Telephone shall have a call party name display (CPND) associated with its DN.
5. Each Courtesy Telephone shall be manufactured by CEECO:
  - a. Model SSW-321-F-ACHW-PBVC-C
  - b. CALL RESTRICT Stainless steel wall telephone, chrome tone dial, MCRK-2 P.C. board, Lexan 32" armored cord, WHITE handset, pushbutton volume control and confidence. CAC 6.00 software.
  - c. 301-037 Security tool – 5/32" #9020 BLUE. Required for installation.
  - d. CEEC Contact – pmccreary@ceeco.net – 1-888-357-0798
6. Courtesy Phone Stainless Steel Backboards
  - a. "COURTESY PHONE" Letters 1-1/4" Height Helvetica Medium engraved and painted black.
  - b. Distributed by Volume Millwork Inc.
  - c. Part#: 10-SPTHELLETTE
  - d. Description: Courtesy Tellette
  - e. Contact: Edwin Chatoor– (713) 538-1451 - [robin@vmillwork.com](mailto:robin@vmillwork.com)
  - f. Must be lockable using key (contractor to request in writing from HAS Technology what key the lock shall be keyed to)

## 2.012 CAT 6 Media extender

### A. Manufactured by Veracity Global

1. Model – Outreach Max XT
  - a. POE/POE + compatible
  - b. IP 66 rating
  - c. Can be wall mounted but preferred method is inside of a NEMA enclosure
  - d. RJ45 connectors

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install components in accordance with contract drawings, manufacturer's instructions and approved submittal data.
- B. System installation and construction methods shall conform to the requirements of the Federal Communications Commission.

- C. The Contractor shall install all system components including furnished equipment, and appurtenances in accordance with the manufacturer's instructions, and adjustments required for a complete and operable system.
- D. Grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.
- E. The HAS IT Representative shall perform final configuration of the network equipment. This includes, but is not limited to: VLAN configuration, IP addressing schemas, final port assignments, and trunking/bonding configurations. Installation contractor shall ensure that the proper documentation is provided to assist in the final system configuration.
- F. The Contractor shall coordinate with the cabling contractor with the installation if the iPatch/imVision crossconnect panel to create a true cross-connect per iPatch/imVision standards.

### 3.02 PRODUCT HANDLING

- A. The Contractor shall be responsible for any and all loss or damage in the shipment and delivery of all material until transfer of title to the City.

### 3.03 HARDWARE INSTALLATION

- A. The Contractor shall obtain written permission from the City Engineer before proceeding with any work which requires cutting into or through any part of the building structures such as, but not limited to, girders, beams, concrete, carpeted or tiled floors, partitions or ceilings. The Contractor shall also consult with the City Engineer before cutting into or through any part of the building structures where fireproofing or moisture proofing could be impaired.
- B. The Contractor shall take all steps necessary to ensure that all public areas remain clear or are properly marked during installation or maintenance.
- C. The Contractor shall develop a detailed network map to be utilized as a road map during the implementation of the LAN. This map shall show all segments, all interconnects between segments and all active network devices. This network map shall not include the individual nodes interconnected to each concentrator, but will have the modules, interfaces, protocols, addresses and other identifying features for each concentrator and other active device.
- D. The Contractor shall also develop a Cable Plant interconnectivity chart showing all fiber patch panels and individual identifiers for each fiber associated with the interconnectivity of each network device.
- E. Prior to installing Wireless Access Points, conduct and document an RF site survey to determine the maximum operating range between an AP (fixed location) and mobile stations for a specified transmit power level. Survey shall also identify holes of coverage due to multi-path, interference sources, and interference from other wireless installations.
- F. The contractor shall place materials only in those locations that have been previously approved. The City Engineer shall approve any other locations, in writing.

### 3.04 SYSTEM STARTUP

- A. The Contractor shall not apply power to the system until after:
  - 1. System and components have been installed and inspected in accordance with the manufacturer's installation instructions.
  - 2. A visual inspection of the system components has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
  - 3. System wiring has been tested and verified as correctly connected as indicated.
  - 4. All system grounding and transient protection systems have been verified as properly installed and connected, as indicated.
  - 5. The City Engineer and the HAS IT Representative have approved the installation.
  
- B. Satisfaction of the above requirements shall not relieve the contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as a result of contractor's deficient work/defective equipment.

### 3.05 ACCEPTANCE TESTING

- A. The contractor shall develop and execute an onsite acceptance-testing program.
  
- B. The plan shall address all requirements identified in this specification and test all contractor supplied cabling and hardware components. The plan shall follow accepted industry testing practices and have a method of independent verification described.
  
- C. Any specified item that does not satisfy the requirements of this specification shall be replaced, upgraded, or added by the contractor as necessary to correct the noted deficiencies. After correction of a noted deficiency, re-testing shall be performed to verify the effectiveness of the corrective action.

### 3.06 IDENTIFIERS, LABELS AND LABELING SYSTEM

- A. All Identification and Labeling shall follow Specification: 270553–Identification and Labeling of Communication Infrastructure. **Any deviation from the specification must be approved by HAS IT prior to installation.**

END OF SECTION



APPENDIX A

LAN Equipment Schedule (EXAMPLE)

Item	Qty
<b>COMM ROOM 11611</b>	
WS-C3650-24PS	3
GLC-LH-SMD – 1000BASE-LX/LH "long haul" SFP Single-mode	6
<b>COMM ROOM 11715</b>	
WS-C3650-24PS	1
GLC-LH-SMD – 1000BASE-LX/LH "long haul" SFP Single-mode	2
<b>COMM ROOM 11908</b>	
WS-C3650-24PS	2
GLC-LH-SMD – 1000BASE-LX/LH "long haul" SFP Single-mode	4
<b>COMM ROOM 12015</b>	
WS-C3650-24PS	1
GLC-LH-SMD – 1000BASE-LX/LH "long haul" SFP Single-mode	2
<b>COMM ROOM 11812</b>	
WS-C3650-24PS	2
GLC-LH-SMD – 1000BASE-LX/LH "long haul" SFP Single-mode	4
<b>COMM ROOM 12606</b>	
WS-C3650-24PS	3
GLC-LH-SMD – 1000BASE-LX/LH "long haul" SFP Single-mode	6
<b>MDF</b>	
WS-X6848-SFP-2T (for 6509)	4
GLC-LH-SMD – 1000BASE-LX/LH "long haul" SFP Single-mode	36

Item	Qty
WS-X6824-SFP-2T (for 6509)	2

APPENDIX B

TECHNOLOGY IMPLEMENTATION SCHEDULE (EXAMPLE)

	(from Designer)		(Contractor Submittal)				(Submittal Response)		
	Product Description	Spec. Ref.	Qty.	Procurement Lead Time	Start Date or Dependent	Installation Duration	Submittal Approved	Purch. Auth.	Remarks
1	WS-C3650-24PS	2.04.D							
2	GLC-LH-SMD – 1000BASE-LX/LH "long haul" SFP Single-mode	2.04.D							
3	WS-X6824-SFP-2T (for 6509)	2.04.C							
4	General Workstation	2.04.G							
5	Network Printer	2.04.H							
6	Cisco Wireless Access Point	2.04.I							
7	Wireless Access Point Enclosure	2.04.J							
8	Cisco 16-port 10 Gigabit Ethernet Copper Module with DFC4 WS-X6816-10T-2T	2.04.E							
9	Cisco 48-port SFP fiber Gigabit Ethernet Module with DFC4 WS-X6848-SFP-2T	2.04.E							
10	Cisco Gigabit Ethernet Module WSX6848-GE-TX	2.04.E							
11		2.04.E							

12	Cisco IOS® Software Release 15.05Y or higher	2.04.E							
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## SECTION 347713.1 – PASSENGER LOADING BRIDGES

### 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. Related Requirements and products not supplied under this section:
  - 1. Section 347713.2 Aircraft Ground Power Units
  - 2. Section 347713.3 Aircraft Pre-Conditioned Air Units
  - 3. Section 347713.4 Potable Water Cabinets

#### 1.2 SUMMARY

- A. Work Includes designing, manufacturing, testing, furnishing, installing, and commissioning passenger loading bridges (PLB) and associated controls and accessory equipment.
- B. This specification sets forth the description, technical and performance specifications for apron drive type passenger loading bridges (PLB).
  - 1. This specification is intended to include only three tunnel type passenger loading bridges and all lengths thereof. Models (or their equivalent) shall include:
    - a. A3-42/70
    - b. A3-47/85
    - c. A3-52/100
    - d. A3-58/116
    - e. A3-61/127
    - f. A3-65/133
    - g. A3-68/144
    - h. A3-72/150
  - 2. Only 3-Tunnel smooth sided truss style walkways will be allowed on this project.
- C. Unless noted otherwise on the drawings, the work shall include everything necessary or incidental to complete the installation including wire raceway (conduit), raceway fittings, outlet boxes, pull boxes, terminal cabinets, 120 volt AC power circuits, and insulated ground cables. Such equipment shall be furnished and installed as Division 26 electrical work. The Contractor shall furnish all necessary information to other

contractor(s) to ensure that a proper conduit system will be installed. Provide accurate as-built drawings indicating all installed conduit and junction boxes.

- D. The Contractor shall cooperate with all other contractors engaged in this project and shall coordinate the passenger loading bridge installation so that all work will proceed in a manner which is in the best interests of the project.
- E. It is the purpose of this specification to require the furnishing of highest quality materials, equipment, and workmanship. The work shall be in accordance with this specification and conform to the designs, layouts, and descriptions on the drawings.

### 1.3 DEFINITIONS

- A. "Aircraft Gate Support Equipment (AGSE)" or "Goods" shall mean various pieces of equipment that the Owner is procuring or supplying for installation for Houston Airport System (HAS). This equipment shall include the following:
  - 1. "PLB" shall mean the new Passenger Loading Bridges.
  - 2. "GPU" shall mean the new Ground Power Units.
  - 3. "PCA" shall mean the new aircraft Pre-Conditioned Air Units.
  - 4. "RTU" shall mean the PLBs cooling unit.
- B. "Authority" or "Airport" or "Owner" or "HAS" may be used interchangeably throughout this Specification and shall mean Houston Airport System.
- C. "Bidder" or "Contractor" or "Supplier" or "Offeror" or "Proposer" may be used interchangeably throughout this Specification and shall mean the individual, partnership, corporation, or other business entity that shall be supplying AGSE and Installation Scope of Work pursuant to this Specification.
- D. "HOU": William P. Hobby Airport. "IAH": George Bush Intercontinental Airport.
- E. Drawings: That part of the Contract Documents prepared or approved by the Owner that graphically shows the scope, intent, and character of the AGSE and Services to be furnished by Contractor.
- F. Project: The total undertaking of which the AGSE and Installation Scope of Work to be provided under the Contract are a part.
- G. Samples: Physical examples of materials, equipment, or workmanship that are representative of some portion or all of the AGSE and which establish the standards by which certain portions of the AGSE or Installation Scope of Work will be judged.
- H. Services: The Scope of Work performed at HOU and IAH.
- I. Shop Drawings: All drawings, diagrams, illustrations, schedules, test reports, certifications, cut sheets, calculations and other data or information which are

specifically prepared or assembled by or for Contractor and submitted by Contractor to demonstrate that the Contractor will provide AGSE and Installation Scope of Work which meet the requirements of the Specifications.

- J. Specifications: Shall mean these Technical Specifications and related Contract Documents.

#### 1.4 INTENT OF CERTAIN TERMS OR ADJECTIVES

- A. The Contract Documents include the terms “as allowed”, “as approved”, “as ordered”, “as directed”, or terms of like effect or import to authorize an exercise of professional judgment by the Owner. In addition, the adjectives “reasonable”, “suitable”, “acceptable”, “proper”, “satisfactory”, or adjectives of like effect or import are used to describe an action or determination of Owner as to the suitability of the Materials used to manufacture new AGSE. It is intended that such exercise of professional judgment, action or determination will be solely to evaluate, in general, the AGSE for compliance with the requirements of and information in the Contract Documents and conformance with the design concept of the completed Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective shall not be effective to assign to Owner any duty or authority to supervise or direct the furnishing of AGSE or any duty or authority to undertake responsibility contrary to any other provision of the Contract Documents.
- B. Unless stated otherwise in the Contract Documents, words or phrases which have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.
- C. The word “non-conforming”, when modifying the word AGSE or Goods, refers to AGSE that fail to conform to the requirements of the Specifications, written Amendments, Change Orders, and written clarifications or interpretations issued by the Owner.
- D. The word “day” or “days” shall constitute a calendar day of 24 hours measured from midnight to the next midnight. When a numeric indication is given for a number of “days”, it shall mean calendar days not work weekdays.

#### 1.5 GENERAL

- A. The term “Passenger Boarding Bridge”, “Passenger Loading Bridge”, “Boarding Bridge”, “Loading Bridge”, “bridge”, “PLB”, and “PBB” as used within this specification and throughout the contract documents is understood to mean the components, subcomponents, and subsystems that constitute a complete, operable, and maintainable Passenger Loading Bridge and as referred to herein, are synonymous.
- B. The terms, “Seller”, “Contractor”, “Provider”, and “Manufacturer” as referred to herein, are synonymous.

- C. Applicable contract and terminal building drawings will be made available upon written request.
- D. The PLB and all components thereof shall be constructed in accordance with all codes and standards and local laws and regulations applicable to the design and construction of this type of equipment, which are generally accepted and used as good practice throughout the industry, including without limitation, NFPA, Underwriter's Laboratories, OSHA, SAE Publications, American National Standards, Military Standards, etc. The design of all parts and subassemblies shall be in accordance with good commercial practice and shall be the responsibility of the manufacturer to assure safe, efficient and practical design in keeping with requirements peculiar to this type system.
- E. Coordinate with the GPU, PCA, and Potable Water Cabinet equipment for the provisions for, or installation of, all necessary infrastructure prior to final factory painting of the passenger loading bridge. The intent is to eliminate site welding/painting after final factory painting. The Owner must approve any exceptions.
- F. Acceptable PLB manufacturers shall be:
  - 1. ThyssenKrupp Airport Systems, Inc.
  - 2. JBT AeroTech Jetway
- G. The Owner, or Owner's tenant, reserves the right to provide branding on the exterior sides of the installed equipment and desires that this branding not be diminished by excessively large or aesthetically displeasing branding of individual pieces of equipment. All manufacturers branding, labeling, marking, etcetera, on their products shall be small compared to the overall size of the device. All branding shall be submitted for approval. The Owner reserves the right to require any non-approved branding be removed from finished products at no additional cost.
- H. The manufacturer shall be a qualified source, who has been regularly engaged in the engineering, manufacturing, and installation of commercial aviation PLB equipment and components for a minimum of five (5) years and with a minimum of one hundred (100) units installed.
- I. Qualified manufacturers and installers will have completed no less than (5) jobs of similar size and scope within the last five (5) years.
- J. The manufacturer shall have proven technical capabilities and adequate manufacturing facilities together with sufficient financial depth and stability to permit prompt and satisfactory execution of the contract.
- K. Manufacturers are required to satisfy all requirements of this specification and the HAS Design Standards Manual which is available on the HAS website. Should the Manufacturer desire to deviate from any portion, either because the specification or manual is in error, violation of any law or regulation, or is in need of modification to permit a more satisfactory functional and economical design, they must submit a written request for such deviation. The Manufacturer shall not contract, purchase or



cause to be delivered, equipment which does not meet all requirements of this document as specified, without obtaining prior written approval.

- L. The Manufacturer shall be responsible for verifying installation locations and methods and shall notify the Owner of any conflicts or code violations prior to manufacture of the PLB units. Verifications shall include field verifications of terminal building heights, appurtenances, and finishes, including terminal doors; electrical, mechanical, special systems, and communications interfaces; as well as PLB foundation locations, rotations, elevations, and bolt details. Modifications to eliminate conflicts or code violations will be coordinated with and approved by the Owner. Modifications shall be made at no additional cost to the Owner.
- M. The Manufacturer shall furnish and install all necessary equipment to provide a complete, operable, and maintainable unit.
- N. Schedule: See contract drawings for locations/types of PLBs.
- O. Should alternate mounting configurations or physical attributes, other than those specified herein, or indicated on the project drawings, be proposed, manufacturers shall submit alternates

#### 1.6 PROJECT SCOPE

- A. Supply, installation, and twenty-five (25) years turn-key maintenance of new PLBs, GPUs, PCAs, Potable Water Cabinets, and RTUs at HOU and IAH, including all related engineering, design, refurbishment, testing, manufacturing, fabrication, assembly, deliveries, spare parts, training, manuals, special tools, obtaining contract bonds & insurances, shipping charges, installation costs, and any other work related to completion of this contract.
- B. The project will include the removal and scrap of the existing AGSE at HOU and IAH.

#### 1.7 PROGRESS SCHEDULE

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. The work under this Contract shall be complete as specified below.
- C. The new PLBs shall be delivered, installed, and commissioned no later than date specified in the Contract documents.
- D. Within fifteen (15) days after the Notice to Proceed is issued to the Contractor, the Contractor shall submit to Owner an acceptable Progress Schedule of Project activities, including at a minimum:

1. Design, Engineering, Preparation, and Submittal of all Shop Drawings. Note – Shop Drawings are inclusive of ALL submittal requirements, as set forth in these Specifications.
  2. Owner's review and approval of Shop Drawings
  3. Material Procurement
  4. Manufacture of PLB
  5. Contractor's Factory Tests
  6. Factory Tests to be witnessed by Owner, at Owner's discretion
  7. Shipping and Delivery
  8. Removal and Scrap of Existing PLB (when applicable)
  9. Installation, testing, and commissioning of new AGSE
- E. The Progress Schedule shall be in Gantt Chart format and be developed utilizing MS Projects Software or other Project Scheduling Software approved by the Owner.
- F. The Progress Schedule will be acceptable to Owner if it provides an orderly progression of the submittals, tests, and deliveries to completion within the specified Milestones and the Contract Times. Such acceptance will not impose on Owner responsibility for the progress schedule, for sequencing, scheduling, or progress of the work nor interfere with or relieve Contractor from Contractor's full responsibility, therefore. Such acceptance shall not be deemed to acknowledge the reasonableness and attainability of the schedule.

#### 1.8 SHIPPING AND DELIVERY

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. Contractor shall select the carrier and bear all costs of packaging, transportation, insurance, special handling, and any other costs associated with shipment and delivery.
- C. Contractor shall deliver the new AGSE, F.O.B. Point of Destination, in accordance with the Contract Times set forth in the Contract Documents, or other date agreed to by Owner and Contractor.
- D. Contractor shall provide written notice to Owner at least fifteen (15) days before shipment of the manner of shipment and the anticipated delivery date. Contractor shall also require the carrier to give Owner at least twenty-four (24) hours' notice by telephone prior to the anticipated hour of delivery.
- E. Delivery shall be made to:

1. HOU
2. IAH

#### 1.9 PROJECT MEETINGS AND COORDINATION

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. The Contractor's Project Manager shall schedule, attend, and conduct such Project Meetings as required to:
  1. Ensure the Project is executed successfully.
  2. Ensure that all parties are fully informed of Project requirements, issues, conflicts, clarifications, interpretations, etc.
  3. Resolve any discrepancies or disputes between the Owner and the Contractor.
- C. Travel and per diem costs for any of the Contractor's or their subcontractor's personnel required to travel to HOU or IAH, in any capacity, associated with the Project, and shall be the sole responsibility of the Contractor.
- D. The Contractor's Project Manager shall issue a Monthly Project Status Report to the Owner's designated representative by the fifth (5th) day of each month. This Status report shall include at a minimum, but is not limited to:
  1. Current progress against the Contractor's Schedule.
  2. Current status of all Contractor Submittals.
  3. Any open, unresolved issues or clarifications the Contractor is awaiting a response from the Owner.

#### 1.10 TRAINING

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. The Contractor shall provide separate AGSE Operations and Maintenance classes. These classes will be conducted on-site and shall occur prior to Final Acceptance of the equipment installation.
- C. There shall be a minimum of two AGSE Operations classes which shall include a classroom training course followed by a field training course including allowing each attendee to operate the AGSE and ask questions related to the operations.

- D. There shall be a minimum of one AGSE Maintenance class which shall include a classroom training course followed by a field training course including allowing each attendee to see typical maintenance activities and ask questions related to the maintenance.
- E. Contractor shall submit a Training Syllabus for all training classes to be conducted within thirty (30) days of the Notice to Proceed. Format and content of Contractor's proposed Training classes shall be subject to approval of the Owner.

#### 1.11 EXTRA MATERIALS TO BE SUPPLIED

- A. Tow Bar: Manufacturer shall provide the Owner with one (1) tow bar for each terminal (three (3) tow bars total).
- B. Jack Stands: Manufacturer shall provide the Owner with one (1) PLB jack stand (A-Frame) for each terminal (three (3) jack stands total).
- C. Laptop:
  - 1. Manufacturer shall provide the Owner with one (1) new laptop for each terminal (three (3) laptops total).
  - 2. Laptops shall be equipped with necessary software and interconnecting cables for maintenance staff to interface and/or troubleshoot problems with the PLC computers.
- D. Hurricane Tie-Down Kits: Manufacturer shall provide one hurricane tie-down kit per bridge.

#### 1.12 SPARE PARTS

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. The Contractor shall provide a recommended spare parts list for spare parts that may be required during first two years of normal operation of the AGSE. This recommended Spare Parts List shall be provided prior to the shipment of the new AGSE.
- C. This recommended spare parts lists shall include the manufacturer's item description, part number, assemblies per unit, the recommended on-hand stocking level, and the current list price.

### 1.13 WARRANTY

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. Contractor warrants and guarantees to Owner that the title to new AGSE conveyed shall be proper, its transfer rightful, and free from any security interest, lien, or other encumbrance.
- C. Contractor warrants and guarantees to Owner that the new AGSE conforms to the requirements of the Contract Documents, including this Specification and any samples and Shop Drawings approved by Owner.
- D. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
  - 1. abuse, improper modification, or improper maintenance or operation by persons other than Contractor; or
  - 2. normal wear and tear under normal usage.
- E. Contractor's obligation to furnish the new AGSE in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of new AGSE that are non-conforming, or a release of Contractor's obligation to furnish the new AGSE in accordance with the Contract Documents:
  - 1. observations by Owner;
  - 2. recommendation by Owner or payment by Owner of any progress or final payment;
  - 3. use of the new AGSE by Owner;
  - 4. any acceptance by Owner or any failure to do so;
  - 5. the issuance of a Final Acceptance notice by Owner; or
  - 6. any inspection, test or approval by Owner or Owner's representatives.
- F. Owner shall within a reasonable time notify Contractor of any breach of Contractor's warranties or guarantees. If Owner receives notice of a suit or claim as a result of such breach, Owner also may give Contractor notice in writing to defend such suit or claim. If Contractor fails to defend such suit or claim, Contractor will be bound in any subsequent suit or claim against Contractor by Owner by any factual determination in the prior suit.
- G. The Contractor warrants to the Owner that all materials (namely the new AGSE) furnished under this Contract shall be of good quality, free from faults and defects and in conformance with Contract requirements. Any work not so conforming to these standards may be considered defective. If, within one (1) year after the date of Owner's final acceptance of the work, the new AGSE are found to be defective or not

in accordance with Contract requirements, the Contractor shall correct it at no cost to the Owner within five (5) days after receipt of written notice from the Owner to do so.

- H. For any new PLB supplied for this Project, the Contractor shall provide:
1. An extended 2-year Warranty from final acceptance agreeing to replace, repair, or restore any defective materials and workmanship of the AGSE.
  2. An extended 5-year Warranty from final acceptance agreeing to replace any PLB defective motors and inverters; motors and gearboxes; horizontal drive motors; gearboxes and control systems; wheel bogie assembly; lift column assemblies; and control systems; hydraulic power units; roller assemblies' tunnel frame work and sheet metal in its entirety; cab assembly, rotating and side shifting drive components, bearings and sheet metal enclosures' rotunda assembly and sheet metal enclosures; cab and rotunda curtain assemblies to include motors, shafts, bearings, bushings, guides and control systems; canopy assembly and control system; articulating floor assembly and control system; auto level components and control system; all electrical harnesses, connector blocks, and components related to the electrical operating systems; and all PLC/computer systems for the bridge.
  3. These extended warranties shall be in addition to, and not a limitation of, other rights the Owner may have against the Contractor under the Contract Documents.
- I. The Contractor shall supply Warranty Certificates, in favor of the Owner for all AGSE supplied under this Contract. Such Warranty Certificates shall be supplied with the Final Payment Application.
- J. The Contractor shall supply the Manufacturer's Warranty Certificates, in favor of the Owner, for all new AGSE supplied under this Contract. Such Warranty Certificates shall be supplied with the Final Payment Application.
- K. The Warranty obligations of the Contractor defined herein shall not be limited by any obligations otherwise prescribed by law.
- L. Upon Final Acceptance of the new AGSE, the Contractor shall furnish a good and sufficient Warranty / Maintenance Bond, in the sum of not less than 100% of the Contract amount, guaranteeing that that Contractor will faithfully fulfill the Warranty obligations of the Contract. Such bond shall remain in effect at least one year after the date of final acceptance, except as required by additional warranty and guarantee periods stipulated by Laws or Regulations.
- M. The Warranty / Maintenance Bond shall be executed by a Surety:
1. Satisfactory to the Owner
  2. Licensed to conduct business in the State of Texas
  3. Named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 by the Financial Management Service, Surety Bond Branch, and U.S. Department of the Treasury.

- N. Bonds signed by an agent must be accompanied by a certified copy of such agent's authority to act.
- O. The bonds, along with appropriate Power of Attorney, shall be delivered to Owner, but in no event shall these documents be delivered to the Owner later than fifteen (15) days from the date of Final Acceptance of the AGSE. If, at any time after the execution of the Warranty / Maintenance Bond as above required, Owner shall deem the surety or sureties upon such bond to be unsatisfactory, or if, for any reasons, such bond ceases to be adequate to cover the performance of the Warranty, Contractor shall, at its expense within five (5) days written notice from the Owner to do so, furnish additional bond or bonds in such form and amount and with such surety or sureties as shall be satisfactory to the Owner.
- P. If the Surety on a bond is declared bankrupt or becomes insolvent or its right to do business in the State of Texas or it ceases to meet the requirements of the Warranty clauses stated above, the Contractor shall provide another bond and Surety which comply with those requirements within 5 days, at Contractor's expense.

#### 1.14 MANUALS

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. One searchable electronic and three (3) copies of the new AGSE OEM's O&M manuals shall be provided prior to the AGSE O&M training.

#### 1.15 MATERIALS

- A. Unless otherwise indicated, it is understood and agreed that ANY materials used or otherwise incorporated into the installation of the AGSE or in the manufacture of the AGSE by the Contractor shall be NEW and UNUSED. If required by the Owner, the Contractor will furnish satisfactory evidence as to the kind and quality of materials and equipment.
- B. Whenever an item of material or equipment to be incorporated into the new AGSE is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Contractor or manufacturer, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, other items of material or equipment or material or equipment of other suppliers or manufacturers may be submitted to Owner for review and approval.
  - 1. If in Owner's sole discretion, such an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related work will be required, it may be considered by Owner as an "or equal" item.

2. For the purposes of this clause, a proposed item of material or equipment may be considered functionally equal to an item so named if:
  - a. in the exercise of reasonable judgment, Owner determines that:
    - 1) it is at least equal in quality, durability, appearance, strength, and design characteristics; and
    - 2) it will reliably perform at least equally well the function imposed by the design concept of the completed Project as a functioning whole; and
  - b. Contractor certifies that:
    - 1) there is no increase in any cost including capital, installation or operating to Owner; and
    - 2) the proposed item will conform substantially, even with deviations, to the detailed requirements of the item named in the Contract Documents.
- C. The Owner will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Paragraph 2 above. Owner will be the sole judge of acceptability. No "or equal" will be ordered, manufactured, or utilized until Owner's review is complete, which will be evidenced by an approved Shop Drawing. Owner will advise Contractor in writing of any negative determination. Notwithstanding Owner's approval of an "or equal" item, Contractor shall remain obligated to comply with the requirements of the Contract Documents.
- D. The Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any such proposed "or-equal."
- E. Contractor shall provide all data in support of any such proposed "or equal" at Contractor's expense.

#### 1.16 GENERAL REQUIREMENTS

- A. The PLB manufacturer shall be in the specific business to design and manufacture the specially constructed PLBs required by this Specification. The Contractor must have a minimum of ten (10) years' experience in producing the PLBs design proposed. The PLB design being proposed MUST have been in continuous use for a minimum of ten (10) years. Specific design features included in this ten (10) year requirement shall be the PLBs:
  1. tunnel side wall structural panels
  2. tunnel roller system
  3. vertical drive system
  4. horizontal drive system
  5. electronic controls system



- B. The PLB shall be Apron Drive 3-tunnel, and shall be designed to extend from a FWW or terminal building face to the aircraft boarding door. This design shall enable passengers to enplane during normal or emergency operations while providing an environment which is protected from hazardous and atmospheric conditions. The PLB shall provide a simple, convenient, and controlled method for boarding passengers. The complete assembly shall be protected against inclement weather conditions, both when sealed against an aircraft and when parked with the weather doors closed.
- C. The drawings and data provided with this RFP are a proposed aircraft layout and PLB model selection which has been developed by HAS. These are provided as reference for the Contractor.
- D. The Contractor shall be fully responsible to conduct a site survey to verify the site conditions, which shall include, but are not be limited to:
  - 1. Center of PLB anchor bolt pattern, anchor bolt placement, size and projection, elevation and orientation to face of terminal building, and centerline of the terminal door.
  - 2. Condition and makeup of terminal building fascia and how interior and exterior flashing will be installed.
  - 3. Any terminal building overhang that will impede installation of the PLB rotunda.
  - 4. Elevation of the terminal floor at the terminal door.
  - 5. Location of electrical service for PLB, PCA, GPU, RTU, and Potable Water Cabinet.
  - 6. Location of communication circuit for PLB.
- E. The Contractor shall conduct such site survey and submit their report of the survey results within 60 days of the NTP and shall submit to the Owner a report of its findings and any impacts existing site conditions will have on the supply and installation of the PLB.
- F. Contractor shall be fully responsible to ensure that the PLBs are designed and manufactured to conform to the existing conditions of the PLB anchor bolts and building electrical service. If any discrepancies are identified during the installation process that prevent the PLBs from being installed, any and all costs incurred by the Contractor or the Owner to resolve such discrepancies shall be borne by the Contractor.
- G. Contractor shall coordinate with the Owner and provide the necessary PLB foundation loading reaction data, anchor bolt pattern and location requirements, and building electrical and communication service requirements for each installation. Contractor shall provide the above information with their Proposal.

## 1.17 SUBMITTALS

- A. Bid-Submittals: The following submittals shall be included with bid.
1. Alternates.
  2. Spare Parts List: Provide manufacturer's recommended spare parts list.
  3. UL Certifications.
- B. Pre-Manufacture Submittals: The following submittals shall be made as necessary to meet the project schedule and shall be submitted and approved prior to manufacturing the PLB.
1. Product data for selected models including specialties and accessories.
  2. Shop Drawings: Provide general arrangement, rotunda elevation and interior, exterior configuration, interior finishes, and electrical power and control schematics.
  3. Installation Details: Provide complete installation details including, without limitation, installation details of all appurtenances. Show installed configuration as well as any pertinent details regarding interface to other equipment and systems, include electrical connection service points.
  4. Passenger loading bridge foundation load reactions.
  5. Certificates of compliance with NFPA 415 current edition from a certified testing company located in the continental United States. The manufacturer shall also provide affidavits attesting to the passenger loading bridge's compliance with NFPA 415 current edition, including the following:
    - a. Provide fire test results per NFPA 415 current edition, Chapter 6 for actual materials provided in the PBB, including walls and floors, flexible closures, cab and rotunda curtain slats, aircraft bumper, and miscellaneous seals and weatherstripping.
    - b. Provide evidence of compliance with NFPA 415 current edition, Chapter 6 design requirements.
    - c. Provide evidence of compliance with NFPA 415 current edition, Chapter 6 materials requirements.
  6. Furnish notarized certifications that the bridge and fixed walkway, including all electrical, mechanical and hydraulic designs, components and installations meet the requirements prescribed in this Specification.
  7. Resume or CV of manufacturers project manager.
  8. Site Survey Report, with all dimensions and information about terminal building, electrical service, and rotunda foundation
  9. Samples: Physical examples of materials, equipment, or workmanship that are representative of some portion or all of the PLB and which establish the standards by which certain portions of the PLB will be judged.

10. Equipment Schedule: Provide size in CFM for each air moving system, amount of outside air each system provides, label all equipment on the schedule, cooling/heating coil information, make and model number, etc.
- C. Pre-Ship Submittals: The following shall be submitted and approved prior to shipping PLBs to the project site:
1. Factory Acceptance Testing Reports: Indicate factory acceptance tests and results and inspection procedures.
  2. Installation Subcontractor and resume or CV of Installation Site Manager.
  3. Written Notice to Owner of scheduled delivery date and time at least 15 days prior to shipment.
- D. Pre-Substantial Completion Submittals: The following submittals shall be submitted and approved prior to 14 days before substantial completion, unless otherwise noted herein.
1. Operation and Maintenance Manuals.
  2. Training Program: At least 60 days prior to substantial completion, a training program summary, course syllabus, instructor qualifications, and copy of the training manual shall be submitted for review and approval.
  3. On-Site Functional Testing Report: Submit proposed on-site functional testing report for approval.
- E. Pre-Final Acceptance Submittals: The following submittals shall be submitted and approved prior to 14 days before final acceptance.
1. As-Built Drawings. Provide field edited redlined project drawings showing deviations from design documents.
  2. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and have been registered with the manufacturer.
  3. On-Site Functional Testing Report: A completed field on-site functional testing report for each installed unit as specified herein. Utilize approved form.
  4. Training Rosters. Provide training roster with trainee names, dates, and types of training, as well as durations.
  5. Original software and documentation registered in the Owner's name.
  6. Hard copy and electronic version (compact disk or flash card) copies of all programs and settings loaded into equipment provided hereunder.

#### 1.18 APPLICABLE CODES AND STANDARDS

- A. The PLB shall be designed and manufactured to meet U.S. Codes and Regulations that have been adopted by the Passenger Loading Bridge industry. Portions or all of

certain recognized industry or association standards referred to herein as being a requirement of these Specifications shall be considered as binding as though the reproduced in full herein unless supplemented and/or modified by more stringent requirements in this Specification. Unless otherwise stated, the reference standard shall be the standard which is current as of the date of issuance of these Specifications.

B. Applicable Industry and Association Standards:

1. Design: Society of Automotive Engineers (SAE) Aerospace Recommended Practice (ARP) 1247, FAA Advisory Circular AC-150/5210-5, Americans With Disabilities Act (ADA), Occupational Safety and Health Administration (OSHA)
2. Structural: American Institute of Steel Construction (AISC), Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings. American Welding Society (AWS) Standards.
3. Material: Structural Plate/Steel/Shapes: ASTM-A36; Structural Tube: ASTM-A500; Steel Pipe: ASTM-A53; Steel Sheet: ASTM-A570; Steel Plate: ASTM-A514; Hinge Pins: ASTM-A311 Grades 1018 & 1144; Bolts: High Strength SAE-J429 Grades 5 & 8 or ASTM-A325 & A440.
4. Mechanical: Mechanical components and designs shall conform to the relevant recommendations and standards established by the Society of Automotive Engineers (SAE) and the American Society of Mechanical Engineers (ASME).
5. Electrical: The PLB shall be listed by a Nationally Recognized Testing Laboratory (NRTL), such as ETL, for conformance to applicable ANSI/UL codes. All equipment and methods of installation conform, where applicable, to the requirements and recommendations of the National Electrical Manufacturers Association (NEMA), the National Electrical Code (NEC), latest issue and State, county and local construction and electrical codes.
6. Paint: Surface preparation and painting shall conform to the guidelines and standards of the Structural Steel Painting Council (SSPC).
7. Fire Protection: The PLBs design shall comply with NFPA 415 current edition. Select materials and components shall be tested per NFPA 415 current edition. Select materials shall comply with the material specifications of NFPA 415 current edition.

1.19 AIRCRAFT MIX

- A. The PLB must be capable of servicing the aircraft mix as identified in the Project Drawings included with the RFP.

1.20 GENERAL DESIGN REQUIREMENTS

- A. The PLB shall be designed and proven capable of servicing all specified aircraft.

- B. Major assemblies and components shall be able to be disconnected and removed from the PLB without the necessity for extensive disassembly.
- C. PLBs horizontal speed shall be smooth, continuously variable, and controlled by the “Joy” stick depression and the use of the steer buttons.
- D. The PLB and any walkways must be ADA compliant with regards to slope, ramps, and handrails. The slope of PLBs transition ramps, with the PLB in a level position, shall meet 1:20. It is understood that the Owner’s selection of the PLB model will ultimately determine the overall slope of the PLB.
- E. The PLB must fully comply with the requirements of Chapter 6 of NFPA 415 current edition.
  - 1. The major components of the PLB, identified below, MUST have passed the fire tested per Chapter 6, Section 6.4 of NFPA 415 current edition.
    - a. 6.4.6 – Walls and Floors
    - b. 6.4.7 – Flexible Closures
    - c. 6.4.8 – Cab and Rotunda Curtain Slats
    - d. 6.4.9 – Aircraft Bumper
    - e. 6.4.10 – Miscellaneous Seals and Weather-stripping
  - 2. PLB design shall comply with the design requirements of NFPA 415 current edition, Chapter 6, Sections 6.1 and 6.2.
  - 3. The specific materials identified Chapter 6, Section 6.3 of NFPA 415 current edition shall comply with the requirements of NFPA 415 current edition, Chapter 6, Sections 6.3.
- F. Independent 3rd Party Certification from an NRTL of compliance with the requirements of NFPA 415 current edition (items 6.a, 6.b, and 6.c above) and the applicable ANSI/UL codes must be supplied with the Contractor’s Proposal.
- G. In addition, independent 3rd Party Labeling from an NRTL, such as UL or ETL, shall be affixed to the name plate of the PLB prior to shipment, either by permission or by inspection of the Independent 3rd Party NRTL. This labeling shall indicate compliance to the requirements of NFPA 415 current edition and the applicable ANSI/UL codes.
- H. All equipment control cabinets shall comply with UL 508A and shall be labeled as complying with UL 508A.
- I. PLB shall operate as designed under ambient temperature conditions of –31 to 125 degrees F.
- J. The PLB shall be designed and manufactured to support the following loads. These loads may be applied in total or in part, singularly or simultaneously. The design shall

be based on the combination that imposes the most adverse loading. In addition to the dead loads and strain caused by movement, the entire PLB will support:

1. A live load of 40 psf.
  2. A wind load of:
    - a. Retracted and stowed – A wind velocity of 90 mph.
    - b. Operational – A wind velocity of 60 mph.
    - c. Retracted and tied down, per the Manufacturer's specified requirements, and a wind load of 139 mph.
  3. A roof load of 25 psf.
- K. The PLBs structural design shall provide sufficient torsional rigidity to avoid excessive sway when the PLB is brought to a stop.
- L. Tire footprint loading shall NOT exceed 300 psi. This shall be the loading PER tire.
- M. The PLB shall be capable of support typical gate ancillary equipment such as pre-conditioned air unit (PCA), 400 Hz ground power unit (GPU), RTU, potable water cabinet, and ventilators. PLB shall be capable of supporting 10,000 pounds of additional load in the form of ancillary equipment. Any ancillary equipment will be mounted at or near the vertical lift columns either underneath or on the side of the PLB. Mounting auxiliary equipment other than the RTU on the roof is not allowed
- N. The PLB Contractor shall submit with their Proposal the mechanical load calculations and assumptions verifying the ability of the PLB to meet the live, wind and roof loads AND support without undo strain, the 10,000 pounds of ancillary equipment.

## ELECTRICAL REQUIREMENTS

### 1.21 INPUT POWER

- A. PLB power supplied at the gate will be 480 Volt, 3-phase, w/ ground, 60 amps. Junction boxes shall be supplied at the terminal building face.
- B. The PLB shall utilize 3-phase, 480 Volt 60 Hertz supply power and shall require a MAXIMUM of 60 amps to operate all functions of the PLB.
- C. The PLB shall have its own transformer to convert the supplied 480 Vac power to 120 / 240 Vac for lighting, outlets, controls, etc. and 24 Vdc for the PLC and other control functions.
- D. The Contractor shall make the required electrical connections in the junction boxes at the terminal building face and the Rotunda Disconnect Cabinet or individual equipment disconnects.

- E. Electrical wiring from the Junction Boxes on the Terminal Building to the PLBs disconnect or individual equipment disconnects shall be enclosed in conduit with one section of flexible conduit and shall be in compliance with NEC, NEMA and state, county and local construction and electrical codes.
- F. It is the Contractor' responsibility to determine these electrical / conduit requirements and supply any required conduit / connection materials.

## 1.22 EQUIPMENT DISCONNECTS

- A. There shall be lockable, SST, NEMA rated disconnects mounted on the rotunda column and accessible to maintenance technicians standing at ground level for the PLB, PCA, GPU, RTU, and Potable Water Cabinet. The center of the disconnect handle or circuit breaker shutoff shall NOT be greater than 54 in. from ground level.
- B. Conduits and SO Cord should not enter the disconnect cabinet or the individual disconnect through the top. Penetrations shall be through the bottom or sides.
- C. The new PLB shall have the following breakers in the SST Disconnect cabinet or separate SST fused disconnects at the PLB rotunda for:
  - 1. 60-amp circuit for PLB
  - 2. Circuit for GPU (varies per gate)
  - 3. Circuit for PCA (varies per gate)
  - 4. Circuit for Potable Water Cabinet (varies per gate)
  - 5. 30 amp circuit for RTU
- D. If a single SST disconnect cabinet is supplied,
  - 1. Separate circuit breakers for the PLB, PCA, GPU, RTU, and Potable Water Cabinet the PLB transformer and the various PLB 110/220 auxiliary, lighting and control circuits shall be supplied.
  - 2. A laminated component layout diagram and wiring schematic shall be affixed to the interior door of the cabinet.
  - 3. The electrical components and workmanship of the disconnect cabinet shall comply with the items P and Q of 1.23 General Electrical Requirements.
  - 4. The cabinet door shall be gasketed.
  - 5. The cabinet shall have a means to allow condensate or water leakage to drain from the cabinet.
  - 6. The cabinet door handle shall have a latching mechanism that engages at both the top and bottom of the cabinet.

7. Each equipment disconnect or circuit breaker must be able to be "Lock / Tagged" out in accordance with OSHA's requirements for Equipment Lock Out / Tag Out requirements. The disconnect cabinet door shall be able to be completely closed and secured when one or more circuit breakers or disconnects are "Locked / Tagged" out.
  8. Each equipment breaker shall be labeled with an engraved placard listing the component the breaker is supplying power to and the voltage and amps of the circuit.
- E. If separate disconnects are supplied for the PLB, PCA, GPU, RTU, and Potable Water Cabinet,
1. Disconnect enclosures shall be SST.
  2. Disconnects shall be located on a mounting plate attached to the rotunda support column.
  3. The mounting plate shall be painted to the same specifications as the rotunda column.
  4. The PLB transformer and the various PLB 110/220 auxiliary, lighting control circuits shall be located in a separate lockable cabinet in the PLB Cab area.
  5. Each SST disconnect enclosure shall be labeled with an engraved placard listing the component the disconnect is supplying power to and the voltage and amps of the circuit.
  6. Each equipment disconnect must be able to be "Lock / Tagged" out in accordance with OSHA's requirements for Equipment Lock Out / Tag Out requirements.

#### 1.23 GENERAL ELECTRICAL REQUIREMENTS

- A. A four pair CAT6 cable, w/ outlet shall be located on the cab wall near the control console for the installation of telephone or intercom equipment. This outlet shall have a SST cover plate.
1. Contractor shall employ a qualified subcontractor to connect the PLB communications (telephone) circuit to the junction box at the terminal face.
- B. Duplex GFI outlets (un-switched 110V, single phase, 20 amp) shall be located:
1. on the lower portion of the drive column,
  2. in the Rotunda or A-Tunnel (near the terminal door),
  3. in the lower exterior of control station.
  4. Interior outlets shall have a SST cover plate.
  5. Exterior outlet shall be SST and weatherproof.



C. Lighting:

1. All 110V and 24V light bulbs and indicators shall be LED.
2. The PLB will not be on an emergency power circuit so the PLB lighting circuit shall have an in-line battery backup system to keep the PLB lighting circuit energized for a minimum of one (1) hour in the event power is lost to the PLB.
3. The interior tunnel, rotunda light fixtures shall be recessed. The interior cab bubble light fixture may be recessed or surface mounted. The cab exterior light fixture shall be weatherproof and surface mounted. These fixtures shall utilize a minimum of two (2), four (4) ft. 110V LED tube lamps.
  - a. The fixtures shall blend with the ceiling design and be oriented in the same direction as the ceiling tile.
  - b. Fixture trim shall be black.
  - c. The lenses of the tunnel, rotunda and cab light fixtures must be captured and prevent the LED tubes from falling into the interior or exterior cab floor of the PLB.
  - d. The first A-Tunnel light shall be located within 24 in. of the rotunda end of the A"-Tunnel.
4. The placement of the interior light fixtures and the number of LED tube lamps per fixture shall provide an average light intensity at floor level, throughout the PLB of 20-foot-candles.
5. Three-way switches shall be located in the Rotunda Corridor or Walkway (right side near the terminal door) and on the wall or power panel near the service door. These switches shall control interior tunnel, rotunda and Cab lights and the exterior Cab light.
6. Light switches shall have SST cover plates.
7. The light is provided over the Operator Console shall be switched on / off from the HMI screen.
8. Exterior floodlights, controlled from the PLBs Operator's station, shall be provided:
  - a. Two (2) on the underside of the cab to illuminate the apron area around and under the PLB.
  - b. One (1) at the lift columns to illuminate the PLBs wheel area. This light shall be located so that the illumination does not interfere with the camera focused on the wheel bogie.
  - c. The lamps for the exterior floodlights shall be Beacon # FL-1-24W-MF-BB 24-watt LED floodlights.
  - d. The three exterior flood lights shall be mounted on the cover of a weather tight, stainless steel (SST), NEMA 3R or 4 rated enclosure. The enclosure

cover shall be hinged, SST and be retained by SST latch(s) or SST self-retaining screws. The enclosure cover shall also have a weather gasket.

- e. Provide the Federal Aviation Administration (FAA) dusk to dawn photo controls.
9. The exterior LED cab light shall be mounted outside the weather doors on the PLB Cab roof and illuminate the cab-aircraft interface. This exterior cab light shall be controlled the tunnel light switch and shall be on when the tunnel lights are on.
  10. An LED weatherproof light fixture shall be located on the exterior of the PLB, outside the Service door, above the landing. The light shall be controlled by a switch located on the interior wall of the PLB, next to the Service door and in the same switch box as the tunnel 3-way light switch. The light switch shall have a SST cover plate. This light shall also have a photocell which will override the interior light switch. The lamp for the service door light shall be a New Star # NWLDM-L30-12-BK-PC 20-watt LED lamp.
- D. Cable Conveyance System:
1. The cable conveyance system shall not impede the normal PLB operation or personnel or equipment traffic around the PLB.
  2. The cable conveyance system shall include input power cables, each sized per the requirements of the equipment requirements.
  3. Cables in the cable conveyance system shall be clamped or strapped to prevent sliding or slippage of the cables.
  4. All power and control cabling between the equipment disconnect(s) at the PLB rotunda and the PLBs C-Tunnel shall be contained in an exterior cable conveyance system mounted either under or on the side of the PLB. All power and control cabling shall be of a "Flat Pak" design. This system shall be accessible at all operational positions of the PLB for maintenance personnel to inspect the system or for replacement or addition of cables.
  5. All cabling contained in a cable conveyance system on the side of the PLB shall be either UV resistant or have a separate UV resistant covering.
  6. All power and control circuit cables from the cable conveyance system shall terminate directly into terminal blocks or the breaker lugs in the equipment disconnect(s) at the PLB rotunda. An intermediate junction box shall not be allowed.
  7. Strain relief shall be provided for all equipment power cables between the cable conveyance system and the equipment disconnect(s) mounted on the PLB Rotunda.
- E. Cable Trays and Conduit:
1. If cable trays are used for the power and control cables to route cables beyond the cable conveyance system towards the cab end of the last PLB tunnel, the cable

- tray shall be aluminum or SST. All other cable trays used on the PLB shall be either galvanized, aluminum or SST.
2. When a Walkway or Extended Corridor is being supplied, all power and control circuit cables MUST be routed in rigid conduit under the Walkway or Extended Corridor. Cable Trays ARE NOT allowed under the Walkway.
  3. No standard electrical and/or communication service conduit or SO Cord shall be permitted on the exterior sides of the PLBs Tunnels or Walkway.
  4. All exterior conduits shall be rigid and shall be attached with rigid conduit clamps.
  5. Any conduit attached to the roof of the PLB Cab, Cab Bubble, Tunnels, Rotunda, or Walkway shall be secured with nelson stud fasteners. Drilling or screwing into the roof is NOT allowed.
  6. Any concealed wiring running within walls, ceilings, floors, or other inaccessible areas must be contained in conduit for the length of the run and must be terminated on a terminal strip in a junction box at each end of the conduit.
- F. Externally mounted electrical equipment panels or cabinets which contain electrical or electronic components and controls, shall be equipped with a thermostatically controlled heater.
- G. Each circuit (e.g. lighting, receptacles, cab floor heat, ventilators, etc.) shall be protected by its own circuit breaker, except low voltage control circuits of 10 amps 50Vdc / 50Vac OR LESS, which may be protected by either circuit breakers or fuses.
- H. All circuits shall have suitable overload protection.
1. Each conductor shall be sized to have current carrying capacity as allowed by the National Electric Code (NEC) equal to or greater than the capacity of the circuit breaker provided for the circuit.
  2. Circuit breakers shall be grouped in convenient locations and suitably marked for size and function.
  3. Protection devices shall be sized to protect wiring, motors and other electrical components from damage due to overload and prevent electrical or mechanical damage to any associated PLB components or ancillary equipment due to failure of any PLB component or ancillary equipment.
- I. Grommets and suitable anti-chafe material shall be used where wires are required to pass through structure or similar relief or opening which exposes the wire to possible chafing.
- J. Quick Disconnect fittings must be MS standard receptacles and plugs and shall be UL or ETL approved. Quick Disconnect receptacles and plugs shall be labeled with a permanent type label to indicate which receptacle goes with which plug.
- K. Toggle switches must be of MIL-S-3950 quality of equivalent and rated for the loads which they control.

- L. Electrical interlocks shall be of a fail-safe design.
- M. All motors and bearings shall be sealed, not requiring lubrication. Actuator mechanisms shall have adequate allowance made for lubrication requirements.
- N. Spark-producing electrical components must be located at least eighteen (18) inches (0.457 m) above ground level.
- O. All Control Cabinets shall comply with UL 508A and must have a UL label attached to the control cabinet door.
- P. Enclosures and Junction Boxes:
  - 1. All exterior enclosure and junction boxes that are labeled shall be labeled with engraved placards.
  - 2. All exterior electrical components, including terminal blocks / terminal strips, shall be housed in weather tight, stainless steel (SST) enclosures of NEMA 3R or 4 rating. The enclosure cover shall be hinged, SST and be retained by SST latch(s) or SST self-retaining screws. The enclosure covers shall also have a weather gasket.
  - 3. All junction boxes, including pass through junction boxes, shall be weather tight, stainless steel (SST) enclosures of NEMA 3R or 4 rating. The enclosure cover shall be hinged, SST and be retained by SST latch(s) or SST self-retaining screws. The enclosure covers shall also have a weather gasket.
  - 4. All exterior electrical devices, including, but not limited to, lights, beacons, sensors, temperature probes, and switches shall be a weatherproof design with a NEMA 3R or 4 rating. All mounting boxes for electrical devices shall be SST and be a weatherproof design with a NEMA 3R or 4 rating. The enclosure cover shall be hinged, SST and be retained by SST latch(s) or SST self-retaining screws. The enclosure covers shall also have a weather gasket. The device should be mounted to the hinged cover.
  - 5. All components mounted in enclosures and junction boxes shall be mounted to a backing plate supplied by the enclosure manufacturer and intended for use in the enclosure or junction box. Mounting directly to the enclosure or junction box wall shall NOT be allowed.
- Q. Wiring and Terminal Blocks
  - 1. All wiring shall be brought to terminal blocks.
  - 2. Wire splices of any type shall NOT be used.
  - 3. Wiring shall be formed and restrained to give a neat appearance.
  - 4. All wires, including spares, within junction boxes, control cabinets, disconnects, other electrical enclosures shall be neatly secured and routed. Wire routing trays shall be used when interior space permits.

5. All wiring shall be identified using stamped labels or other Owner approved wire labels.
  - a. Labels shall be visible and located within 1 in. of their termination point.
  - b. Wires are to be numbered in a logical sequence and all wire numbers are to be indicated on electrical schematics.
6. Spare wires shall be numbered and also labeled as "SPARE". Spare wires shall be indicated on the electrical schematics.
7. Wires must meet the bend radius requirements of NEC. Ninety-degree bends shall not be allowed.
8. Ferrules or insulated ring terminals shall be used on any fine stranded wire, depending on the terminal block connection.
  - a. Fork or Spade terminals shall NOT be allowed.
  - b. Direct connection of fine stranded wire to a terminal block shall NOT be allowed.
9. Terminal blocks shall be either:
  - a. Finger proof or tamper proof design
  - b. Stud or open style design with a protective cover supplied by the terminal block manufacturer.
10. Other terminal block designs shall not be accepted.
11. Terminal blocks must meet the applicable requirements of SAE J561, J858, and J928.
12. Wire ties SHALL NOT be used to securing any wiring. NEC / UL approved clamps and methods must be used to secure wiring.

#### 1.24 CONTROL SYSTEMS

- A. All PLB motion controls shall be by momentary contact type (dead-man) controls.
- B. The PLB shall be equipped with an automatic leveling system (auto-leveler), mounted on the cab floor, interior, right side.
  1. The Auto level mechanism must be in full view of the PLB operator.
  2. It shall be protected to prevent accidental damage or activation from passengers.
  3. The system shall utilize a deployed arm and allow the PLB to follow changes in the aircraft elevation that occur during aircraft loading and unloading.
  4. The system shall function with equal reliability for all aircraft contours and door sill heights.

- C. The auto-leveler is engaged and the Auto Level arm is deployed when the Operator Console Selector Switch is switched to the "AUTO" position.
  - 1. An Auto Level On message shall appear on the PLBs Console HMI screen.
  - 2. When the Operator Console Selector Switch is moved from "AUTO" to "OFF", the Auto Level arm shall be retracted to its stowed position.
  
- D. The auto-leveler circuit shall include a sustained travel timer.
  - 1. The timer shall limit auto-level vertical travel to a maximum of six seconds.
  - 2. The timer shall be adjustable from 1.6 to 6 seconds.
  - 3. A fault condition occurs if the operation exceeds the set time limit.
  - 4. This fault condition shall cause all vertical motion power to be disconnected, a vertical travel brake to be engaged, an audible over-travel alarm on the Operator Control Console to sound, and a warning message to be displayed on the PLBs Console HMI screen.
  - 5. In addition, an audible over-travel alarm will sound and an amber flashing light will be activated, both of which will be mounted near the terminal door in the Corridor or Walkway above the light switch.
  - 6. There shall also be an audible alarm in the general ramp area that produces a distinctly different sound from other PLB alarms.
  - 7. PLB shall be equipped with a "shoe switch" device that can be placed by the operator between the bottom of the aircraft door and the floor of the cab. Should the aircraft lower onto the switch, it will set off the auto level alarm.
  
- E. If the auto level wheel does not make contact with an aircraft as it is deployed, the Auto level alarm shall be activated.
  
- F. To prevent the PLB operator from accidentally turning off and disabling the auto level system, an alarm at the operator console shall sound whenever the selector switch is moved from "AUTO" to the "OFF" position.
  
- G. When PLBs horizontal, vertical, or steer motion is activated, an audible travel alarm bell near the PLB wheel bogie shall sound at 98 decibels, measured at 10 feet from the wheel bogie, and only the wheel bogie flood light shall be illuminated. The flood lights under the PLB cab near the aircraft spacer shall only be illuminated from the PLBs operator console.
  
- H. Mechanical or electrical interlocks shall be provided to prevent damage to control circuits or PLB components by selecting opposite motions simultaneously.
  
- I. When the PLB Operator selector switch is in the "OFF" or "AUTO" position, the controls for all PLB horizontal movement, vertical movement, cab rotation, ACF floor, and canopy operation shall be inoperative.

- J. If the GPU cable is deployed or if either of the PCA or GPU is operating, the controls for all PLB horizontal movement shall be inoperative.
- K. If the GPU cable is deployed or if either of the PCA or GPU is operating, AND the PLB Operator selector switch is moved to the "Operate" position, a warning message shall be displayed on the HMI and an alarm will sound.
- L. If the PLB lift columns are electro-mechanical, the PLB shall be equipped with Lift Column sensors to detect a Lift Column "Rack" condition. If the PLB lift columns become unsynchronized, power shall be removed from the vertical lift columns and a warning message shall be displayed on the PLBs Console HMI screen.
- M. When the canopy is deployed, the controls for all forward and reverse PLB horizontal movement shall be inoperative.
- N. The PLB shall have the following "soft" travel limits, which can be set and adjusted by the Owner.
  - 1. PLB Swing – Left and Right
  - 2. Lift Column Vertical – Up and Down
  - 3. PLB Slope
  - 4. PLB Tunnel Extend / Retract
  - 5. Cab Rotate – Left and Right
- O. When the PLB is approaching a soft limit setting, an audible alarm shall sound on the Operator Control Console and a warning message shall be displayed on the PLBs Console HMI screen.
- P. If the soft limit is reached, the PLB horizontal and vertical motion shall be stopped and operator shall be able to clear the soft limit by operating the PLB in the reverse direction.
- Q. In addition to the soft limits, a mechanical "hard" limit system shall be provided for PLB Swing, Lift Column Vertical Up / Down, and PLB Tunnel Extend / Retract Travel limits.
- R. If any of the mechanical "hard" limits are reached, all operational control power to the PLB shall be switched off so the PLB cannot be moved or operated. Then, a Keyed By-Pass Switch located inside the lockable Operator Control Station, must be used to return power to the PLB so it can be brought back into safe operating limits and conditions.

#### 1.25 OPERATOR CONTROL STATION

- A. The Operator Control Station shall be located in the PLB Cab and shall provide the operator with a control console and the service utilities required to accomplish PLB operation and docking to the specified aircraft. This Operator Control Station shall be

forward facing and positioned so the operator has an unrestricted full view of the aircraft door during maneuvering and docking operations.

- B. The Operator Control Station area shall be protected from the outside environment by closable weather doors and shall be housed in a NEMA-rated enclosure. Operation of the PLB shall be accomplished without opening the weather doors.
- C. The Operator Control Station shall be located so as to provide minimum obstruction to passenger traffic and to minimize the possibility of passengers tampering with the PLB controls.
- D. The Main Power Panel and the Operator Control Cabinet or Cabinets shall:
  - 1. Have a front access panel or door that is latched at the top and bottom or side to side and is lockable with a key.
  - 2. Utilize an interlock switch with by-pass capability.
  - 3. Access panel or door shall be hinged and have a door hold open cylinder or be removable.
- E. The interior of all main power panels or control cabinets shall have a thermostatic controlled heater.
- F. The Operator Control Console shall be located at the Operator Control Station.
- G. PLB Camera System.
  - 1. The PLB Cab shall be equipped with a color LCD monitor 8" x 10" minimum, mounted on an adjustable base and located at operator eye level on the left side Operator Station, not in the Operator Control Console face plate. LCD monitor shall display images from color cameras:
    - a. #1 – mounted on the underside of the C-Tunnel, centered, towards the cab end of C-Tunnel, forward of the PCA unit, before the lift columns, showing the complete wheel bogie area.
    - b. #2 – mounted on the underside of the C-Tunnel, centered on the C-Tunnel and pointing towards the PLB rotunda, showing area under the PLB towards the rotunda.
    - c. #3 – mounted on galvanized uni-strut which is bolted on the PLB Cab roof, above the aircraft side of the service door. The camera view shall be centered on the service stair, showing service platform, stairs, and ramp area around the stairs.
    - d. #4 – mounted on galvanized uni-strut which is bolted to the PLB Cab or PLB C-Tunnel. The camera shall be mounted far enough away from the PLB C-Tunnel so that the PCA / GPU pendant control and PCA hose basket area are clearly shown.



2. The LCD monitor shall be equipped with a switch to toggle between images from cameras #1, 2, 3, or 4 OR display the image from all 4 cameras.
  3. A remote-control device shall NOT be used to operate the monitor on any of the camera system functions.
  4. The LCD monitor shall be powered on when the PLB "Power On" button activated and shall remain in operation while power is on to the PLB.
- H. The Operator Control Console shall include, as a minimum, the following "dead man" controls:
1. A three-position master keyed Console Switch used to select "OFF", "OPERATE", or "AUTO" (automatic leveling). This master keyed Console Switch shall be mounted on the Operator Control Console face plate. A minimum of twelve (12) keys shall be supplied by the Contractor to the Owner.
  2. A lever arm ("Joy" stick) that shall provide control over horizontal forward and reverse movement of the PLB. The Joystick shall, when moved progressively, allow PLB horizontal speed to increase proportionally to the position of the Joystick
  3. Steer Left / Right push buttons for horizontal drive direction.
  4. Vertical Up / Down push buttons for raising and lowering the cab end of the PLB.
  5. Cab Rotate push buttons for cab rotation, left or right.
  6. An illuminated, mushroom type emergency stop button that shuts down all PLB movement when pressed.
  7. A push button to ring the Travel Alarm Bell.
- I. The Operator Control Console shall include an HMI touch screen that:
1. Shall be easily readable and suitable for the environment.
  2. Shall include the required shields or coatings so that the Operator can read the HMI screen regardless of sun glare.
  3. Shall display Operator Error or Warning Messages, PLB Status Conditions, and controls for non PLB movement.
    - a. Non PLB Movement Controls shall include, but are not limited to:
      - 1) PLB Power On / Off
      - 2) Floodlights that illuminate the apron area under the aircraft and under the cab.
      - 3) Spacer limit override, which will override the aircraft proximity sensor and all for final positioning of the PLB.
      - 4) ACF Floor Controls
      - 5) Canopy Extend / Retract

- 6) Cab Floor Heat
  - b. PLB Status Conditions shall include, but are not limited to:
    - 1) POWER ON
    - 2) PLB ON or OPERATE
    - 3) AUTO LEVEL On
    - 4) Canopy Deployed
    - 5) GPU Cable Deployed
    - 6) GPU ON
    - 7) PCA ON
  - c. Operator Error or Warning Messages shall include but are not limited to:
    - 1) AUTO LEVEL Warning
    - 2) Column Fault Error
    - 3) PLB Motion "Soft Limit" Warnings
    - 4) PLB Motion "Hard Limit" Errors
    - 5) Cab Rotate Warning
    - 6) Aircraft Spacer Warning
    - 7) A warning if Console Switch is moved to OPERATE and the PCA or GPU are running or the GPU cable is deployed.
    - 8) All messages displayed shall have an appropriate text message informing the Operator of the nature of the alarm or PLB status.
- J. All Operator Control Console switches and controls shall be clearly labeled.

#### 1.26 VERTICAL DRIVE

- A. The PLB shall move vertically by means of two lift column assemblies. Each assembly shall be independent with individual drive systems. Each assembly shall be capable of supporting the PLB under full design load, providing 100% redundancy.
- B. The Contractor may supply either:
  1. a hydraulic vertical drive system, or
  2. an electromechanical vertical drive system.
  3. The Contractor must state in their Proposal which type of Vertical Drive system will be supplied.

- C. If a hydraulic vertical drive system is supplied:
1. The lift cylinders shall be equipped with safety systems to prevent the bridge from descending in the event of fluid loss or other hydraulic system failure,
  2. Mechanical stops in the cylinders shall be provided to prevent over-travel of the lift column. The system shall not be damaged if the bridge is raised or lowered into the cylinder stops.
  3. The lift cylinders shall be removable for replacement without the requirement to modify, cut, or damage any PLB component.
  4. The lift cylinders and the entire hydraulic system shall be self-bleeding to prevent air entrapment in the system.
  5. The hydraulic system shall include:
    - a. A drain pan to prevent hydraulic fluid from dripping onto the ramp. Drain pan shall be equipped with a drain valve in the bottom of the drain pan.
    - b. Relief valves to prevent system over pressurization
    - c. Replaceable Hydraulic Fluid / Water Separator Filter OR Replaceable Desiccant Breather
    - d. Pressure Gauge
    - e. Temperature Gauge
    - f. Fluid Level Gauge
    - g. Tank and block heaters to keep hydraulic fluid warm in cold weather
  6. Hydraulic lines that are routed through the cross tube of the wheel bogie shall be protected by a plate on both sides of the wheel bogie cross tube. The pendant control mounting plate may be used for this protection of the left side of the wheel bogie cross tube.
- D. If an electromechanical vertical drive system is supplied:
1. Each assembly shall be independent with individual drive systems.
  2. All motors and bearings shall be sealed, not requiring lubrication.
  3. Ball screws, bearings and couplings shall have adequate allowance made for lubrication requirements and ball screw inspection.
  4. A fault detector shall sense differential motion of the lift column assemblies. If a fault is detected,
    - a. electrical power shall be disconnected from the vertical drives and vertical drive brakes shall be engaged.
    - b. horizontal PLB motion and Cab Rotation shall be disabled.

- c. A fault message / alarm shall be displayed on the HMI screen.
5. Mechanical stops on the ball screws shall be provided to prevent over travel of the lift columns.

#### 1.27 HORIZONTAL DRIVE

- A. The horizontal drive system shall permit the PLB to extend or retract and rotate to any point within the operational envelope of the PLB. The PLB steering system and controls shall allow steering in a varying path while simultaneously extending and retracting the PLB Tunnels. The PLB shall also be capable of moving in a straight line when required.
- B. Design and control of the horizontal drive system shall provide smooth starts and stops and positive fail-safe braking. The brakes shall remain engaged with power removed from the PLB.
- C. Horizontal drive shall be electromechanical.
- D. Tires shall be solid, with an aircraft tire style tread (e.g. straight line) and designed specifically for the proposed PLB model.
- E. An integral spring-applied electrically released brake shall be provided with the drive motor. The brake shall lock the PLB in place when electrical power is disconnected. This shall also occur when the joystick is in the neutral position.
- F. The horizontal drive motor shall be equipped with a manual brake release. This shall permit the PLB to be towed in the event of power failure. The brakes shall automatically reset if power is reapplied to the horizontal drive motor.
- G. Tow lugs, permanently affixed, shall be provided on the lower wheel frame.
- H. All drive chains, drive shafts or couplings shall be protected with guards.
- I. The horizontal drive system shall include a "safety hoop" system the fully encompasses both wheels and will stop all motion of the PLB when the safety hoop is contacted by a person or obstruction on the ramp near the PLB wheels.
  1. The design of the safety hoop system shall not cause injury or damage to the individual or object contacted.
  2. The safety hoop shall utilize limit switches or pressure switches so that if ANY part of the circumference of the safety hoop is contacted, the PLB horizontal drive system shall be disengaged, a warning or error message is displayed on the HMI, and an alarm sounds at the operator console. Horizontal motion can only be resumed if the PLB "ON" button is used to restart the PLB operation.

## 1.28 ROTUNDA

- A. The rotunda assembly shall be designed as the self-supporting terminal end pivot for the PLBs vertical and horizontal motion.
- B. The rotunda shall be designed so that there are no physical connections to the Terminal Building that could transmit loads or vibrations to the Terminal Building.
- C. The rotunda shall include flap type seals to provide weather protection between the rotunda and the hinged telescoping tunnel section AND at the connections of the Rotunda Curtain to the Rotunda structure.
  - 1. These seals shall be both interior and exterior at the top, bottom, left and right sides, and shall comply with NFPA 415 current edition Section 6.3. Brush type seals are acceptable on the exterior.
- D. The Rotunda shall have exterior hinged Cab Curtain covers. Hinges shall be SST or galvanized and shall be piano type, running the full length of the cover.
- E. The Rotunda Curtains shall be the manufacturer's standard.
- F. The rotunda assembly shall swing through a range of 175 degrees total; 87.5 degrees clockwise and 87.5 degrees counterclockwise from the terminal door centerline.
- G. The rotunda shall utilize a columnar support and be capable of mounting to a foundation with a #7 anchor bolt pattern. The center of the #7 bolt pattern will be in line and parallel with the center of the terminal or walkway door opening and 4'-6" from the terminal building or walkway finished face.
- H. The rotunda floor shall remain stationary regardless of PLB movement. The rotunda floor shall remain level at all times.
- I. Limits located on the rotunda assembly shall include PLB slope and PLB over-travel swing.
  - 1. Slope limits shall be adjustable up to 12.00 percent (or the maximum threshold where the AGSE equipment will not sustain damage) for both up and down slopes. This limit shall be adjustable to meet local operating conditions and requirements. The PLB shall be configured to operate at PLB slope greater than 8.33 percent to allow travel to an aircraft, that when mated, will result in a PLB slope of 8.33 percent.
  - 2. The over-travel swing limit system shall be adjustable to meet local conditions. When activated, the system shall disable PLB movement in the direction of fault but allow the PLB to move in the opposite direction.
  - 3. The over-travel swing limit system shall activate the warning alarm and the warning message display two (2) degrees prior to the activation of the PLB motion-disabling capability of the over-travel swing limit system.
- J. The rotunda roof shall have a fall protection tie off point.

- K. The Rotunda ceiling and floor shall be insulated with R8 insulation.
- L. Provide a 3,000 cubic feet per minute (cfm) power ventilator installed on the roof of the rotunda for use with bridge cooling and heating. Ventilator shall be equipped with a back-draft damper.
- M. Provide a grounding stud on the rotunda base plate.

#### 1.29 CORRIDOR / WALKWAYS

- A. The design of the corridor / walkway shall allow the installation of flexible weather seals and a floor threshold to the face of the terminal building or fixed passageway without reliance on the terminal to provide any degree of structural support.
- B. All Walkways shall be rectangular in cross section and constructed in the same manner as the PLB tunnels.
- C. Sheet metal interior flashing shall be installed between the corridor / walkway and the terminal building. Sheet metal shall be galvanized or galvanealed. The flashing shall only be attached to the corridor / walkway. Flashing shall be painted to match the interior paint of the PLB. Felt backing shall be installed on flashing to protect the surfaces of the Terminal Building from damage caused by the movement of the flashing.
- D. Exterior flashing shall be installed between the corridor / walkway and the terminal building. The flashing material shall meet the requirements of NFPA 415 current edition, Section 6.3 and 6.4.10.

#### 1.30 TUNNELS

- A. All tunnels shall be rectangular in cross section.
- B. The minimum inside width of the tunnels shall be as follows:
  - 1. Minimum width, wall-to-wall 57.5 inches
  - 2. Minimum interior height 84 inches
  - 3. Minimum inter-tunnel ramp width 53.5 inches
  - 4. Minimum corridor width 52.0 inches
- C. A transition ramp shall accommodate the difference in elevation where telescoping tunnel sections overlap.
  - 1. The transition ramp(s) shall meet a slope of 1:20 when the PLB is level.
  - 2. The transition ramp shall have a safety yellow strip running the full width of the ramp nosing. The yellow strip must be durable and withstand the wear of passenger and roller bag traffic.

3. The Transition ramp nosing shall be designed to provide a smooth, even, unobstructed walking surface area, from the tunnel floor to the ramp.
  4. The transition ramp shall be hinged, with a SST “piano” style hinge. Other methods of attachment to the PLB tunnel are not acceptable.
- D. Tunnel end caps shall be painted to match the Owner selected wall panel finish.
- E. If the tunnels utilize interior rain gutters, they shall be continuous aluminum extrusion, yellow rubber rain gutters or other Owner approved design. If aluminum extrusion gutters are supplied, yellow / black safety tape shall be installed in the aluminum gutters. If rubber rain gutters are supplied, the following installation requirements shall apply.
1. Both the tunnel metal floor surface as well as the rubber gutter material shall be cleaned with Methyl Ethyl Ketone (MEK) and allowed to dry.
  2. 3M 1099 Adhesive or Owner approved equal shall be applied to both the tunnel metal floor and rubber gutter material.
  3. The rubber gutter shall be placed on the tunnel metal floor and rolled smooth to ensure an even coating of adhesive on both surfaces.
  4. The rubber gutter material shall then be removed to allow the adhesive to dry on both surfaces.
  5. Once the adhesive is dry the rubber gutter material shall be placed back on the tunnel metal floor and rolled smooth to ensure a proper bond.
- F. The rain gutter diverters from A to B and B to C tunnel shall be free of obstructions that prevent the free flow of water and debris.
- G. The Tunnels shall include flap type seals to provide weather protection between any fixed tunnel and extendable tunnel. These seals shall be installed on both ends of the A-Tunnel and the Cab end of the B-Tunnel. These seals shall prevent rain, snow, wind, air, or light infiltration from penetrating the interior of the PLB rotunda or PLB tunnels.
- H. When the PLB is in the positive slope condition, e.g. the Tunnels are raised above the level position of the rotunda floor elevation, water cannot leak into the Rotunda area from the exterior seals surrounding the entrance/connection of the A-Tunnel into the Rotunda
- I. The tunnels shall have interior fire seals, top rain gutter water diverter blocks, interior rainwater diverters and underside rubber splash diverters.
- J. All seals, both interior and exterior, shall comply with NFPA 415 current edition Section 6.3
- K. If the PLB tunnel roofs are a “flat” roof design, water diverters shall be incorporated onto the PLB roofs to divert rainwater away from the end of the PLB tunnels. If the

PLB is in a positive slope or a negative slope, the exterior rain diversion system will prevent rainwater from entering the PLB rotunda or the PLB tunnels.

- L. The tunnel ceilings shall be insulated with R8 insulation the full width and length of the ceilings, including above and beside the lighting fixtures.
- M. The tunnel floors and walls shall be insulated with R8 insulation.
- N. All three tunnels shall have the manufacturer's standard fall protection cable system supplied.
- O. The tunnels shall be equipped with ice scrapers.
- P. Provide four (4) tie-down connection points and suitable straps to achieve 139 mph wind rating requirement.

### 1.31 CAB

- A. The PLB Cab shall rotate 125 degrees; 92.5 degrees counterclockwise and 32.5 degrees clockwise from the tunnel centerline.
- B. The PLB Cab shall rotate at a speed of 0 to 145 degrees/min (2.41 degrees/sec).
  - 1. Limit switches or sensors and physical hard stops shall prevent over-rotation of the Cab.
  - 2. Cab rotation shall be disabled when the PLB is in the Auto Level mode or the Canopy is deployed.
  - 3. Cab rotation shall be controlled by a Variable Frequency Drive (VFD).
  - 4. Cab rotate motor shall be low temperature rated.
- C. An aircraft spacer shall be located at the aircraft end of the Cab floor and shall span the full width of the Cab floor.
  - 1. The spacer material shall be an E.P.D.M. or other suitable polymer and have passed the fire test specifications of NFPA-415 current edition.
  - 2. The spacer material must be sufficiently flexible and non-abrasive to prevent scratching or other damage to the aircraft fuselage.
  - 3. The aircraft spacer shall be yellow and the contact surface with the aircraft shall be flat and the contact surface with the aircraft shall be a minimum of five (5) inches
- D. Cab shall have an Adjustable Cab Floor (ACF), which shall:
  - 1. be self-leveling regardless of PLB slope and cab orientation to the aircraft.
  - 2. provide a surface that parallels the centerline of the aircraft fuselage such that passengers transiting between the PLB and the aircraft step onto a level surface.



3. level automatically and shall also be adjustable by means of a manual operate override.
  4. shall utilize a piano style hinge, minimum 1-1/2 in x 1-1/2 in x 1/8 in, continuous the full length of hinged area, SST or coated for corrosion protection.
- E. RJ aircraft will be serviced using a separate ramp so there is no requirement for a retractable PLB Cab floor and special PLB Cab Handrails. However, the PLB cab floor and canopy must be designed for the ERJ 135 / 145 aircraft with respect to fuselage configuration and interference with any PITOT or other sensors. The appropriate canopy arm extension, floor extensions and floor cutouts will be supplied for ERJ 135 / 145 docking.
- F. The area of the Cab where the Operator stands shall have windows for operator visibility.
1. The windows shall be located in front, left and right of the operator.
  2. Glass in the front and right shall be safety glass.
  3. Glass in the left shall be wire reinforced glass.
  4. A tinting shall be applied to each window to minimize glare but shall not limit visibility.
  5. Cab windows shall have a defrost feature.
- G. Weather doors shall be provided adjacent to the console to seal and secure the interior when the PLB is not in use.
1. These doors shall be swinging double doors that open inward and can be latched closed.
  2. The latch mechanism shall be a SST sliding rod that latches the door closed to the door frame. A foot operated door latch shall not be allowed. A door to door latch shall not be allowed.
  3. The door shall also have a hold open mechanism mounted between the top of the cab swing door and the door frame.
  4. The clear width of the weather doors when open is 43-1/2 inches.
  5. The upper portion of each door shall be equipped with a 12 inches wide X 32 inches high (305 mm x 812 mm) safety glass window to enhance visibility and shall be equipped with 1/2 door height wire reinforced safety glass windows to enhance visibility.
  6. The doors shall have a stainless-steel kick plate at the bottom of both sides of both doors.
- H. The Cab Curtains shall be the manufacturer's standard with one row of windows in cab curtain slats.

- I. The Cab shall include flap type seals to provide weather protection between the Cab structure and the Cab Curtain. These seals shall be both interior and exterior and shall comply with NFPA 415 current edition, Section 6.3. Brush type seals are acceptable on the exterior.
- J. The Cab shall have exterior hinged Cab Curtain covers. Hinges shall be SST or galvanized and shall be piano type, running the full length of the cover.
- K. The Cab shall be equipped with an adjustable type aircraft closure (canopy) to “seat” the Cab against the aircraft fuselage and surround the opening between the Cab and the aircraft. The aircraft closure must conform to the contours of the aircraft types specified and provide a reasonably tight weather seal.
  - 1. The aircraft closure shall be compliant with the specifications outlined in Chapter 6 of NFPA current edition.
  - 2. The aircraft closure covering will not absorb water, shall be highly tear resistant, and remains flexible from -31 to 127 degrees F. The canopy frame structure shall be an A-300 structure.
  - 3. The inner liner shall cover the canopy frame members.
  - 4. The aircraft closure color shall be gray.
  - 5. The aircraft closure shall be a deployable and retractable bellows type canopy and when deployed against the aircraft, the aircraft closure system shall be designed to maintain a slight pressure and seal against the aircraft fuselage.
  - 6. If the aircraft closure is mechanically actuated, pressure sensitive switches shall be incorporated into the closure mechanisms to prevent excessive pressure on the aircraft.
  - 7. The canopy material contacting the aircraft shall be a soft material to prevent scratching or damage to the aircraft skin. The sections of the canopy material that contact the aircraft shall be segmented for easy replacement.
  - 8. The outer layer shall be a weather and UV resistant material with seams sealed to prevent water from leaking into the inner layer of material.
  - 9. All contact points of the canopy (canopy pads) shall be attached to the main canopy structure using Velcro fasteners.
  - 10. If the aircraft closure is mechanically actuated, the outer canopy assembly shall have 3 top support straps, located at the: Left side, center, and right side. These straps shall be part of the canopy material and shall be fasten at one end to the cab wall frame and the other end attached to the front canopy seam.
  - 11. There shall be an A-300 type Canopy Hood Cover to protect the retracted canopy material from being affected from heavy snow or rain. This cover may be a permanent part of the cab structure or may be a removable hood cover for shipping and/or fabric replacement.

12. The PLB Cab shall incorporate the required features in the aircraft closure, auto level, Cab bumper and Cab floor necessary for the PLB to dock to the ERJ 135/145 with a swing out "plug" door and a CRJ 200/700/900 with fold down door, handrails down. A sliding floor section for CRJ docking is NOT required.
13. Passenger Loading Bridge Identification Signs shall be supplied by the manufacturer for each bridge. These three-sided illuminated triangular signs are mounted to the top of the PLB end cab and are visible from any angle by the pilots as they approach the gate area. The gate number is approximately 2'-5" high with a readable distance of 600 feet or more. The aluminum-fabricated structure will be painted to match the color of the passenger loading bridge and will have 1/4" thick acrylic sign faces with surface sprayed color. The letters will be masked during the spraying process and, when removed, the translucent acrylic will be revealed. Approximate size of the sign faces will be 4'-3". This sign will require out-door weatherproof detailing.
  - a. Coordinate font and font size of lettering with the Owner as well as the Terminal Building Package signage drawings as applicable. Submit for approval.
  - b. Gate signs shall be activated by an adjustable photoeye. Power shall be distributed via a circuit breaker within the electrical control cabinets. External switches that may inadvertently be turned off will not be allowed.
- L. The Cab roof bearing shall have a grease fitting for maintenance.
- M. All sections of square tubing used as structural support for the cab bubble and cab floor shall have a 1/4-inch drain hole in the underside of the tube.
- N. The Cab shall have the manufacturer's standard fall protection tie off point.
- O. The 5 ton RTU shall be mounted to the roof of the Cab.
- P. The Cab bubble ceiling shall have R8 insulation.
- Q. The exterior Cab floor shall have Cab floor heaters, which shall be controlled from the Operator console.
  1. Cab Floor Heater: Provide 240-volt, 1.75 kilowatt (kW) minimum cab floor heater with a manual control switch and indicator light located in the control console. Provide a minimum 20-amp circuit breaker and thermostatically controlled or self-regulating heater mat. The "On/Off" switch must be accessible by service personnel only.
- R. The Cab shall have provisions for a PCA temperature probe to be mounted on the exterior cab wall, below the forward-facing cab window.

### 1.32 SERVICE DOOR, LANDING, STAIRS

- A. Unless otherwise specified in the contract drawings, all landings shall be an 8' extended landing from the standard configuration.

- B. The service stairs shall face the terminal building and shall not interfere with any auxiliary equipment mounted on the side of the PLB.
- C. The PLB shall have a caged, OSHA compliant, roof access ladder, which shall be accessed from the Service Stair Platform.
- D. The roof access ladder, cage and roof handrails shall be hot-dipped galvanized.
- E. A service door, landing, and stair leading to the apron area constitute the service access.
- F. The service door shall have a stainless-steel kick plate at the bottom of both sides of the door.
- G. The service access shall be located on the right-hand side of the cab end of the PLB.
- H. The service door shall be fully accessible, from both inside the PLB and from the service landing, in all possible extend / retract conditions of the PLB.
  - 1. The transition from the service landing, through the service door to the PLB interior shall be smooth and flat, free of any step or ledge between the PLB interior floor and the service landing.
  - 2. A latch shall be provided to hold the service door open and shall be located on the service platform railing a minimum of twenty-four (24) in. above the service platform. The latch shall be bolted to the middle handrail of the service platform. The latch shall be a McMaster-Carr 1407A5 latch or Owner approved equal.
  - 3. The service door shall be steel, hollow core, with a 20" x 29" minimum wire glass window and shall meet or exceeds the 3/4-hour fire rating per ASTM E152. The door shall be a minimum of 2'-6" wide 2'-5" clear and 6'-7" high.
  - 4. The service door shall be equipped with medium-duty commercial-type hardware and automatic door closure.
  - 5. The service door shall open outward onto the landing.
  - 6. The service door shall be equipped with Simplex Model 1000 combination lock, with Best Lock core and key override on the outside of the service door.
  - 7. The service door frame shall have 1/4-inch water drain holes at the bottom / underside of the tubing frame to allow condensate water to drain out.
- I. The service stair platform shall be constructed of hot-dipped galvanized steel, with a metal Deckspan / Gripstrut walking surface and shall:
  - 1. have a one-piece galvanized courtesy plate, installed under the platform covering.
  - 2. be protected on the open sides by galvanized steel handrails and toe rails that are designed to meet OSHA standards.
    - a. The handrail at the outer edge of the platform shall be equipped with a baggage transfer opening, at the center railing area, to afford use of a

baggage slide or baggage transfer ramp operations. The opening shall be protected with a galvanized chain secured on one end and detachable on the other end. The top handrail section and bottom toe rail section of the opening must remain.

3. be equipped with an additional support arm bracket, (bolted) installed from the cab beam to the main platform tube galvanized support bracket. This support is to add additional support to the platform for installation of baggage slide system.
  4. All sections of square tubing used as structural support for service platform and bag slide shall have a 1/4 inch drain hole in the underside of the tube
- J. The service stair shall be equipped with self-adjusting risers and tread, of a metal Deckspan / Gripstrut, with a serrated edge for a gripping surface.
1. All steps shall have an equal rise. The tread width shall be 28 inches and the maximum tread rise is 9 1/2 inches.
  2. The service stair shall be equipped with handrails on each side that comply with OSHA standards for handrails located at stairs.
  3. The entire service stair assembly shall be galvanized.
  4. The service stair shall be accessible to ramp service personnel at all operational heights and positions of the PLB.
  5. The service stair wheels shall have grease fittings in wheel axel and swivel bearing. The wheel tread shall be designed with a tread to minimize wear.
- K. The Contractor shall supply a J&B bag slide mounted on the service stairs and shall include the service stair wheel extension required for the bag slide.

### 1.33 SLOW AND STOP PROXIMITY SENSORS

- A. The manufacturer shall equip each PLB with a proximity switch system, or comparable, to prevent the bridge bumper and stair landing from hitting the aircraft, causing damage.
1. For the bumper proximity sensor, at 2' to 10' (adjustable) from the aircraft, slow-down circuitry shall be initiated, slowing forward movement to half speed. As the bridge continues to approach the aircraft, stop proximity sensors shall activate, no part of the bumper will be permitted to come within 0" to 2" (adjustable) of the aircraft. Appropriate forward motion and cab rotation in the direction of the aircraft will be locked out to prevent the bridge from contacting the aircraft. Movement away from the aircraft will be unrestricted.
  2. For the stair landing, two proximity sensors are to be installed, and at 2' from the aircraft, an audible alarm shall be initiated.

#### 1.34 PROVISIONS FOR POTABLE WATER CABINETS

1. Either a new or existing potable water cabinet shall be mounted to the left side lift column of the apron drive passenger loading bridge.
2. Passenger loading bridge manufacturer disconnect enclosure shall provide a separate circuit breaker to supply power to the potable water cabinet.
3. The passenger loading bridge manufacturer shall provide a new mounting bracket that can be attached on the left side of the passenger loading bridge adjacent to the lift column. This bracket shall be painted to match the color of the lift columns. The design and mounting requirements shall be the responsibility of the passenger loading bridge manufacturer.
4. A potable water cabinet water hose shall be provided that can be routed from the potable water cabinet back to the building face for connection to the building plumbing system. This hose can be pre routed or installed in the field.
5. The potable water cabinet shall be interlocked with the passenger loading bridge to prevent the passenger loading bridge from moving while the doors are open, and the hose is extended.

#### 1.35 ARCHITECTURAL REQUIREMENTS

##### A. Ceiling

1. The ceiling in the Rotunda, Tunnels, Cab Bubble, and Cab shall be the manufacturers standard. Color to be chosen by the Owner.

##### B. Paint Specification

1. Interior – Exposed to passengers – Carbon steel surfaces shall be mechanically cleaned per requirements of SSPC and paint manufactures requirements. Galvanealed steel surfaces shall be cleaned with solvent. Paint shall be a two (2) coat system with rust inhibiting epoxy primer and polyurethane top-coat. The Owner shall choose interior paint color from the standard colors available from the PLB manufacturer.
2. Interior – Not exposed to passengers – Carbon steel surfaces shall be mechanically cleaned per requirements of SSPC and paint manufactures requirements. Galvanealed steel surfaces shall be cleaned with solvent. Paint shall be one coat of rust inhibiting epoxy primer applied per manufacturer's standard process.
3. Exterior – Carbon steel surfaces shall be mechanically cleaned per requirements of SSPC and paint manufactures requirements. Galvannealed steel surfaces shall be cleaned with solvent. Paint shall be manufacturer's standard three (3) coat system or Owner approved equal.

##### C. Wall Treatments

1. The interior tunnel wall treatment shall consist of the manufacturer's standard wall panel system and shall meet the fire rating requirements of NFPA 415 current edition. The wall panel color shall match the interior paint color selected by the Owner.

D. Flooring

1. Rotunda, Walkways and Tunnels – 3/4" Marine Grade Plywood or Metal sub-floor and Manufacturer's standard wall to wall carpet. No carpet tile shall be allowed.
2. A radiused 3-4" wide diamond threshold plate shall be used between the circular rotunda floor and the floor to the PLB A-Tunnel and no carpet pound down shall be required around the circumference of the rotunda floor. If a diamond threshold plate is not used in the rotunda, then carpet pound down shall be installed around the circumference of the rotunda floor.
3. If there is a wide, hinged diamond threshold plate between rotunda floor and the A-Tunnel floor, carpet shall be installed on this plate, covering the full width of the plate as close to the A-Tunnel wall as possible.
4. Transition Ramps – 1-1/2" Marine Grade Plywood sub-floor and Manufacturer's standard wall to wall carpet. No carpet tile shall be allowed. Carpet shall be extended from PLB tunnel over transition ramp hinge in one piece to cover transition ramp. Carpet bars shall be attached with screws or rivets.
5. Cab Bubble – 3/4" Marine Grade Plywood or Metal floor w / 1/4" (6.4mm) thick black ribbed rubber floor covering. A radiused 3-4" wide diamond threshold plate shall be used between the cab bubble floor and cab floor and no carpet pound down shall be required around the circumference of the cab bubble floor.
6. Cab Exterior – Metal subfloor with 1/4" (6.4mm) thick black ribbed rubber floor covering
7. If marine grade plywood is used as sub-floor, each wood piece shall be sealed a minimum of 3" from all edges with a fiberglass marine resin.
8. All plywood floor seams and fastener holes shall be filled and sanded smooth
9. Seams in plywood sub floor shall be staggered and shall not run the full width of the PLB Tunnel or Walkway. All seams shall be filled, blended and sanded smooth.
10. Any screws used to attach sub-floor that protrude through metal panels of Tunnels, Walkways, Rotunda or Cab, shall be trimmed off and painted.
11. Owner shall choose carpet color from standard colors offered by the PLB Manufacturer.

E. Tunnel, Walkway, Corridor Handrails

1. Handrails shall meet the requirements of ADA Section 505.

2. SST or brushed aluminum handrails shall be provided the full length and on both sides of the A-Tunnel, Walkway and Extended Corridors.
3. SST or brushed aluminum handrails shall be provided at the A to B and B to C tunnel transition ramps, both sides.
4. The handrails in the ramp area shall run the full length of the transition ramp.
5. Handrails shorter than the length of the floor transition ramp shall not be accepted.
6. Handrails shall be curved toward the walls at all terminations to prevent snagging by passenger clothing and luggage.
7. Return ends shall be capped and tight against the wall panel to prevent purse, luggage straps from being caught.

#### 1.36 CERTIFICATIONS

- A. The PLB shall be certified by a NRTL for compliance to the applicable UL codes and NFPA 415 current edition. Evidence of such certification from the NRTL must be supplied with the Contractor's Proposal OR prior to Contract award.
- B. Independent 3rd Party Labeling from an NRTL, such as UL or ETL, shall be affixed to the name plate of the PLB prior to shipment, either by permission or by inspection of the Independent 3rd Party NRTL. This labeling shall indicate compliance to the requirements of NFPA 415 current edition and the applicable ANSI/UL codes.
  1. MIL-STD-704E (Aircraft Electrical Power Characteristics)
  2. MIL-STD-461B (Electromagnetic Interference Characteristics)
  3. ARP-5015 (SAE, Aerospace Recommended Practices)
  4. ARP-1940 (SAE, Aerospace Recommended Practices for Solid State Frequency Converters.
  5. ARP-1247 (SAE, Aerospace Recommended Practices for 400 Hz Ground Power Performance Requirements)

#### 1.37 FACTORY ACCEPTANCE TESTING

- A. Contractor's Factory Testing Plan
  1. The Contractor and/or new equipment Manufacturer shall develop a Factory Testing Plan, as part of its overall Quality Plan, which identifies the specific testing to be done at the Contractor's and/or new equipment Manufacturer's factory. The Factory Tests must confirm, to the extent possible in Contractor's and/or new equipment Manufacturer's factory that all features, functions and capabilities of the AGSE, as defined in the Specification and Contract Documents, are performing as intended. The Factory Test Plan shall be submitted with the Contractor's Quality



Plan and approved by the Owner thirty (30) days prior to any Factory Tests being conducted.

2. It is the intent of the Owner that the Contractor and/or new equipment Manufacturer shall develop a comprehensive Factory Test Plan, identifying the specifics of the tests to be carried out, and the acceptance criteria of such test, to ensure the AGSE comply with the requirements of the Specification and Contract Documents.
3. Factory mass flow tests shall be conducted for each size of PCA units at design ambient conditions with a test apparatus whose resulting calculated mass flow has been certified by the NEBB or other approved Agency. The submittal for the PCA units shall include the agency certification report of the test apparatus, sealed, and authenticated by the agency.
4. Should factory tests fail to indicate compliance with specifications, all costs associated with re- testing, including costs associated with the Owner's witness services, will be the responsibility of the manufacturer.
5. Owner or his representative shall have the right to witness these tests, for which purpose a 5-day notification shall be given before performance.
6. Complete test reports shall be submitted within 2 weeks of factory test.
7. The first unit shall be type tested at actual design summer condition for capacity and performance.

#### 1.38 ON-SITE FUNCTIONAL TESTING

##### A. Contractor's On-Site Testing Plan

1. The Contractor shall develop an On-Site Testing Plan, as part of its overall Quality Plan, which identifies the specific testing to be done by the Contractor after the AGSE are installed at IAH. The On-Site Testing must confirm that all of the AGSE function as intended, alone and in conjunction with each other and provide the required features, functions and capabilities as defined in the Specification and Contract Documents. The On-Site Test Plan shall be submitted with the Contractor's Quality Plan and approved by the Owner thirty (30) days prior to any On-Site Tests being conducted.
2. It is the intent of the Owner that the Contractor shall develop a comprehensive On-Site Test Plan, identifying the specifics of the tests to be carried out, and the acceptance criteria of such test, to ensure the AGSE comply with the requirements of the Specification and Contract Documents.
3. In-Process Field Testing and Inspection: All installed equipment shall be inspected, all wiring checked for proper continuity, and units checked for leaks in accordance with the applicable specs and standards.
4. On-Site Acceptance Tests: Recognizing that it is impractical to simultaneously duplicate the design ambient, aircraft activity, and passenger loads for performing system capacity, acceptance criteria for system rating will be based on certain

capacity measurements and interpolation/extrapolation of data. These criteria and procedures will be mutually agreed to by the Supplier and Owner before the performance of the acceptance tests.

5. Following check out and inspection by the Supplier, a complete acceptance test shall be made of each gate system using live aircraft and shall be witnessed by the Owner.
6. Tests shall comprise those in the approved test procedure.
7. Complete test reports shall be submitted within 10 working days of completion of the actual tests.
8. Test reports shall contain suitable data reduction and calculation to verify the goals of the test plan and the system capacity.

### 1.39 GENERAL QUALITY ASSURANCE REQUIREMENTS

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. The quality assurance requirements for this project shall focus on ensuring Contractor and/or new equipment Manufacturer refurbishes, designs, manufactures, delivers and installs the required equipment that fully complies with the requirements of this Specification.
- C. The quality assurance requirements shall consist of:
  1. The Contractor's and/or new equipment Manufacturer's Quality System – Consisting of the Contractor's and/or new equipment Manufacturer's Quality Manual and Quality Procedures
  2. The Contractor's and/or new equipment Manufacturer's Quality Plan – The Quality Plan developed by the Contractor and/or new equipment Manufacturer and to ensure all requirements of this Specification are met.
  3. Contract Review and Design - The Specification Compliance Document, drawings, cut sheets, calculations, third party certifications, test results, etc. submitted by the Contractor and/or Manufacturer for review and approval of the Owner.
  4. Contractor's and/or new equipment Manufacturer's Material Receipt, In-Process Manufacturing and Final Inspections – All receiving, in-process and final inspection documents and reports shall be submitted for review and approval of the Owner.
  5. Factory Acceptance Testing – The Contractor and/or new equipment Manufacturer Factory Acceptance Testing to ensure the new AGSE meets the design requirements of this Specification. The Contractor shall submit reports of such acceptance testing for review and approval of the Owner.

6. Owner Inspection prior to Shipment – The Owner reserves the right to perform an in-factory inspection of all equipment PRIOR to shipment. This inspection shall review compliance to the Specifications and to ensure all equipment has passed Factory Acceptance Testing. Witness of certain Factory Acceptance Testing shall also be part of this in-factory inspection. Travel, lodging, per diem and other costs for the Owner’s representatives to conduct any subsequent inspections required, should the equipment fail the initial inspection, shall be the responsibility of the Contractor.
7. Contractor’s Installation In-Process and Punch List Completion Inspection – All Installation In-Process and Punch List Completion inspection documents and reports shall be submitted for review and approval of the Owner.
8. Owner in Process Installation Inspection – The Owner’s representative will perform an in process inspection during the Installation process.
9. Functional Testing – As part of the installation process, the Contractor shall conduct Functional Testing to verify the equipment meets certain functional requirements of the Specification. All test reports from such Functional Testing shall be submitted to the Owner for review and approval.
10. Owner Final Inspection – The Owner’s representative will perform a final inspection after Final Acceptance is achieved on all equipment. At this time, a Final Punch List will be generated, identifying all non-conformances with the AGSE and Services and the agreed upon date between the Owner and the Contractor for the Contractor to remedy all non-conformances.

#### 1.40 CONTRACTOR’S QUALITY PLAN

- A. The Contractor and/or new equipment Manufacturer shall develop a Quality Plan that identifies the relevant inspection points and acceptance criteria that will be utilized by the Contractor and/or new equipment Manufacturer to ensure all requirements of the Specification are met.
- B. The Quality Plan shall identify the inspection and review points during the contract review, design, manufacturing, and installation where the Contractor and/or new equipment Manufacturer will perform inspections or tests to ensure compliance to the Specifications.
- C. The Quality Plan shall identify the scope of the inspections and tests and the specific acceptance criteria that will be utilized by the Contractor and/or new equipment Manufacturer for each inspection and test.
- D. The Quality Plan shall also identify the test plan, procedures, methods, techniques, etc. that will be utilized by the Contractor and/or new equipment Manufacturer to conduct the required **FACTORY ACCEPTANCE TESTING** and **ON-SITE FUNCTIONAL TESTING**.

- E. The Contractor and/or the new equipment Manufacturer shall submit their Quality Plan to the Owner for approval within sixty (60) days of the issuance of the Notice to Proceed.

#### 1.41 NON-CONFORMING GOODS

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. The Owner has the right to disapprove or reject Goods or Services that the Owner believes to be non-conforming.
- C. If the Owner elects to reject the Goods or Services in whole or in part, Owner's notice to Contractor will describe in sufficient detail the non-conforming aspect of the Goods or Services. If Goods or Services have been delivered to Owner, Contractor shall promptly, and within the Contract Times, remove and replace or modify the rejected Goods or Services.
- D. Contractor shall bear all costs, losses, and damages attributable to the removal and replacement or modification of the non-conforming Goods or Services.
- E. Upon rejection of the Goods, Owner retains a security interest in the Goods and Services or to the extent of any payments made and expenses incurred in their testing and inspection.
- F. If the Owner elects to permit the Contractor to modify the Goods or Services to remove the non-conformance, Contractor shall promptly provide a schedule for such modifications and shall make the Goods or Services conforming within a reasonable time.
- G. Instead of requiring modification or removal and replacement of non-conforming Goods or Services discovered either before or after final payment, Owner may accept the non-conforming Goods or Services. Contractor shall bear all costs, losses, and damages attributable to Owner's evaluation of and determination to accept such non-conforming Goods or Services.
- H. Contractor shall pay all claims, costs, losses, and damages, including but not limited to all fees and charges for re-inspection, retesting and for any engineers, architects, attorneys and other professionals, and all court or arbitration or other dispute resolution costs arising out of or relating to the non-conforming Goods or Services, including the modification or removal and replacement of the non-conforming Goods or Services and the replacement of property of Owner and others destroyed by the modification or removal and replacement of the non-conforming Goods or Services, or the obtaining of conforming Goods or Services from others.
- I. Contractor's responsibility for correcting all non-conformities in the Goods and Services will extend for the Warranty Period as specified in the Contract Documents after the date of Final Acceptance of the Goods and Services, or for such longer period

of time as may be prescribed by Laws or Regulations or by the terms of any specific provisions of the Contract Documents.

- J. Neither payments made by Owner to Contractor prior to any tests or inspections, nor any tests or inspections shall constitute acceptance of non-conforming Goods, or prejudice Owner's rights under the Contract.

#### 1.42 INSPECTIONS

##### A. Factory Inspections

1. The Owner may conduct a Factory Inspection of the new AGSE at the manufacturing location and perform an inspection of the equipment and witness the AGSE tests as set forth in the specification and in the Contractor's and/or new equipment Manufacturer's approved Factory Test plan.
2. The Owner may send up to three (3) representatives to conduct the Factory Inspections.
3. The Contractor shall supply the Owner's inspection representatives with instruments, tools, and equipment and all such assistance as they may find necessary to conduct inspections of the equipment.
4. Contractor shall provide Owner 30-days written notice, prior to shipment, of the readiness of the AGSE for the Owner's inspection. All the AGSE shall be available for inspection and testing at the same time.
5. The Owner shall arrange and pay for all travel, lodging, local transportation, and local meals for the Owner's representatives attending the factory testing.
6. If, on the basis of the Factory inspections and testing, the AGSE appear to be conforming, Owner will give Contractor prompt notice thereof. If on the basis of the Factory inspection and testing, the AGSE appear to be non-conforming, Owner will give Contractor prompt notice thereof and will advise Contractor of the required remedies and if such remedies must be accomplished prior to shipment and if a subsequent inspection by the Owner's representatives will be required prior to shipment.
7. If subsequent factory inspections will be required, as determined by the Owner, the Contractor shall arrange and pay for all travel, lodging, local transportation, and local meals for the Owner's representatives (up to three (3)) to attend this factory re-inspection and re-testing.

##### B. Inspection Upon Delivery

1. Contractor shall inspect the AGSE upon delivery solely for purposes of identifying the AGSE and general verification of quantities and observation of apparent condition in order to ensure AGSE are acceptable and suitable for installation. Such inspection will not be construed as final or as receipt of any AGSE and Services that, as a result of subsequent inspections and tests, are determined to be non-conforming.

2. Within three (3) days of such receiving inspections, Contractor shall provide Owner with written notice of Contractor's determination regarding conformity of the AGSE. In the event Contractor does not provide such notice, it will be presumed that the AGSE are suitable for Installation.

C. Inspection During Installation Process

1. The Owner's representative will conduct one or more inspections during the Installation process to review the Contractor's compliance with the Installation Specification and the rectification of any previously identified non-conformities. The Contractor shall supply the Owner's inspection representative with instruments and all such assistance as they may find necessary.
2. The Owner reserves the right to conduct these Installation inspections, unannounced and at any time during the Installation process.
3. If, on the basis of any inspections or testing, the AGSE or Services appear to be non-conforming, Owner will give Contractor prompt notice thereof will advise Contractor of the required remedies and the required completion date of such remedies.

D. Inspection at Final Acceptance

1. The Owner's representative will conduct a Final Acceptance Inspections when the Contractor has completed the Installation of the AGSE. The Owner's representative shall review all of the AGSE to ensure they are installed properly, that the Services have been completely carried out and that all previously identified non-conformities have been remedied. During this Final Acceptance Inspection, the Contractor shall conduct, with the Owner's representative as a witness, the specified on-site functional testing of the AGSE. The Owner's representative will identify any Punch List items that must be remedied by the Contractor during the Final Acceptance Inspection.
2. The Contractor shall provide seven (7) days written notice to the Owner of the proposed date of Final Acceptance and on-site functional testing.
3. If the AGSE are considered by the Owner to be Substantially Complete and useable for the intended purpose, the Contractor shall issue a Final Acceptance Certificate to the Owner. This Final Acceptance Certificate must list all identified Punch List items, must indicate a due date for the completion of the Punch List items, and must be approved by the Owner.
4. If the Contractor does not receive a signed Final Acceptance Certificate on the required date, as specified in the Contract Documents, the Owner may exercise delay penalties as called out in the Contract Documents.

E. Final Acceptance

1. Once the Contractor has remedied all of the Punch List items, the Owner shall be notified to re-inspect the AGSE and Services. Upon such notification, the Owner's representative shall re-inspect the AGSE and Services to verify the Punch List items have been remedied.

2. If any of the Punch List items have not been remedied to the Owner's satisfaction and subsequent inspections are required by the Owner's representative, the Contractor shall bear any and all costs, including labor, material, travel and per diem, incurred by the Owner to conduct such repeat FINAL ACCEPTANCE inspections.
3. If the Contractor does not remedy the Punch List items by the date identified on the Final Acceptance form, the Owner may exercise delay penalties as called out in the Contract Documents.
4. Once all Punch List items are remedied and accepted by the Owner, the Contractor shall issue a Final Acceptance Certificate, indicating the date the AGSE and Services have been accepted by the Owner. This date will also be the start date of the Contractor's Warranty Period.

END OF SECTION

## SECTION 347713.2 – AIRCRAFT GROUND POWER UNITS

### 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. Related Requirements and products not supplied under this section:
  - 1. Section 347713.1 Passenger Loading Bridges
  - 2. Section 347713.3 Aircraft Pre-Conditioned Air Units
  - 3. Section 347713.4 Potable Water Cabinets

#### 1.2 SUMMARY

- A. Work Includes designing, manufacturing, testing, furnishing, installing, and commissioning 60 Hz to 400 Hz pulse width modulated (PWM) frequency converters rated at a continuous capacity of 90 kVA single output and 180 kVA dual output, to provide 400 Hz power designed to conform to MIL-STD-704 standard for aircraft ground power systems.
- B. Unless noted otherwise on the drawings, the work shall include everything necessary or incidental to complete the installation including wire raceway (conduit), raceway fittings, outlet boxes, pull boxes, terminal cabinets, 120 volt AC power circuits, and insulated ground cables. Such equipment shall be furnished and installed as Division 26 electrical work. The Contractor shall furnish all necessary information to other contractor(s) to ensure that a proper conduit system will be installed. Provide accurate as-built drawings indicating all installed conduit and junction boxes.
- C. The Contractor shall cooperate with all other contractors engaged in this project and shall coordinate the aircraft ground power unit installation so that all work will proceed in a manner which is in the best interests of the project.
- D. It is the purpose of this specification to require the furnishing of highest quality materials, equipment, and workmanship. The work shall be in accordance with this specification and conform to the designs, layouts, and descriptions on the drawings.



### 1.3 DEFINITIONS

- A. "Aircraft Gate Support Equipment (AGSE)" or "Goods" shall mean various pieces of equipment that the Owner is procuring or supplying for installation for Houston Airport System (HAS). This equipment shall include the following:
  - 1. "PLBs" shall mean the new Passenger Loading Bridges.
  - 2. "GPU" shall mean the new Ground Power Units.
  - 3. "PCA" shall mean the new aircraft Pre-Conditioned Air Units.
  - 4. "RTU" shall mean the PLBs cooling unit.
- B. "Authority" or "Airport" or "Owner" or "HAS" may be used interchangeably throughout this Specification and shall mean Houston Airport System.
- C. "Bidder" or "Contractor" or "Supplier" or "Offeror" or "Proposer" may be used interchangeably throughout this Specification and shall mean the individual, partnership, corporation, or other business entity that shall be supplying AGSE and Installation Scope of Work pursuant to this Specification.
- D. "HOU": William P. Hobby Airport. "IAH": George Bush Intercontinental Airport.
- E. Drawings: That part of the Contract Documents prepared or approved by the Owner that graphically shows the scope, intent, and character of the AGSE and Services to be furnished by Contractor.
- F. Project: The total undertaking of which the AGSE and Installation Scope of Work to be provided under the Contract are a part.
- G. Samples: Physical examples of materials, equipment, or workmanship that are representative of some portion or all of the AGSE and which establish the standards by which certain portions of the AGSE or Installation Scope of Work will be judged.
- H. Services: The Scope of Work performed at HOU and IAH.
- I. Shop Drawings: All drawings, diagrams, illustrations, schedules, test reports, certifications, cut sheets, calculations and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to demonstrate that the Contractor will provide AGSE and Installation Scope of Work which meet the requirements of the Specifications.
- J. Specifications: Shall mean these Technical Specifications and related Contract Documents.

### 1.4 INTENT OF CERTAIN TERMS OR ADJECTIVES

- A. The Contract Documents include the terms "as allowed", "as approved", "as ordered", "as directed", or terms of like effect or import to authorize an exercise of professional judgment by the Owner. In addition, the adjectives "reasonable", "suitable",

“acceptable”, “proper”, “satisfactory”, or adjectives of like effect or import are used to describe an action or determination of Owner as to the suitability of the Materials used to manufacture new AGSE. It is intended that such exercise of professional judgment, action or determination will be solely to evaluate, in general, the AGSE for compliance with the requirements of and information in the Contract Documents and conformance with the design concept of the completed Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective shall not be effective to assign to Owner any duty or authority to supervise or direct the furnishing of AGSE or any duty or authority to undertake responsibility contrary to any other provision of the Contract Documents.

- B. Unless stated otherwise in the Contract Documents, words or phrases which have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.
- C. The word “non-conforming”, when modifying the word AGSE or Goods, refers to AGSE that fail to conform to the requirements of the Specifications, written Amendments, Change Orders and written clarifications or interpretations issued by the Owner.
- D. The word “day” or “days” shall constitute a calendar day of 24 hours measured from midnight to the next midnight. When a numeric indication is given for a number of “days”, it shall mean calendar days, not work weekdays.

## 1.5 GENERAL

- A. The term “Aircraft Ground Power Unit”, “Ground Power Unit”, “400HZ”, and “GPU” as used within this specification and throughout the contract documents is understood to mean the components, subcomponents and subsystems that constitute a complete, operable, and maintainable Aircraft Ground Power Unit and as referred to herein, are synonymous.
- B. The terms, “Seller”, “Contractor”, “Provider”, and “Manufacturer” as referred to herein, are synonymous.
- C. Applicable contract and terminal building drawings will be made available upon written request.
- D. The GPU and all components thereof shall be constructed in accordance with all codes and standards and local laws and regulations applicable to the design and construction of this type of equipment, which are generally accepted and used as good practice throughout the industry, including without limitation, NFPA, Underwriter's Laboratories, OSHA, SAE Publications, American National Standards, Military Standards, etc. The design of all parts and subassemblies shall be in accordance with good commercial practice and shall be the responsibility of the manufacturer to assure safe, efficient and practical design in keeping with requirements peculiar to this type system.

- E. Coordinate with the PLB, PCA, and Potable Water Cabinet equipment for the provisions for, or installation of, all necessary infrastructure prior to final factory painting of the aircraft ground power unit. The intent is to eliminate site welding/painting after final factory painting. The Owner must approve any exceptions.
- F. Acceptable PCA manufacturers shall be:
  - 1. JBT AeroTech - Jetway Systems
  - 2. ITW GSE (previously Hobart)
  - 3. FCX Systems
  - 4. Substitutions – Reference Division 01 - General Requirements
- G. The Owner, or Owner's tenant, reserves the right to provide branding on the exterior sides of the installed equipment and desires that this branding not be diminished by excessively large or aesthetically displeasing branding of individual pieces of equipment. All manufacturers branding, labeling, marking, etcetera, on their products shall be small compared to the overall size of the device. All branding shall be submitted for approval. The Owner reserves the right to require any non-approved branding be removed from finished products at no additional cost.
- H. The manufacturer shall be a qualified source, who has been regularly engaged in the engineering, manufacturing and installation of commercial aviation GPU equipment and components for a minimum of five (5) years and with a minimum of one hundred (100) units installed.
- I. Qualified manufacturers and installers will have completed no less than (5) jobs of similar size and scope within the last five (5) years.
- J. The manufacturer shall have proven technical capabilities and adequate manufacturing facilities together with sufficient financial depth and stability to permit prompt and satisfactory execution of the contract.
- K. Manufacturers are required to satisfy all requirements of this specification and the HAS Design Standards Manual which is available on the HAS website. Should the Manufacturer desire to deviate from any portion, either because the specification or manual is in error, violation of any law or regulation, or is in need of modification to permit a more satisfactory functional and economical design, they must submit a written request for such deviation. The Manufacturer shall not contract, purchase, or cause to be delivered, equipment which does not meet all requirements of this document as specified, without obtaining prior written approval.
- L. The Manufacturer shall be responsible for verifying installation locations and methods and shall notify the Owner of any conflicts or code violations prior to manufacture of the GPU units. Verifications shall include field verifications of terminal building heights, appurtenances, and finishes, including terminal doors; electrical, mechanical, special systems, and communications interfaces; as well as GPU mounting provisions and details. Modifications to eliminate conflicts or code violations will be coordinated with

and approved by the Owner. Modifications shall be made at no additional cost to the Owner.

- M. The Manufacturer shall furnish and install all necessary equipment to provide a complete, operable, and maintainable unit.
- N. Schedule: See contract drawings for locations/types of GPUs.
- O. Should alternate mounting configurations or physical attributes, other than those specified herein, or indicated on the project drawings, be proposed, manufacturers shall submit alternates

## 1.6 PROJECT SCOPE

- A. Supply, installation, and twenty-five (25) years turn-key maintenance of new PLBs, GPUs, PCAs, Potable Water Cabinets, and RTUs at HOU and IAH, including all related engineering, design, refurbishment, testing, manufacturing, fabrication, assembly, deliveries, spare parts, training, manuals, special tools, obtaining contract bonds & insurances, shipping charges, installation costs, and any other work related to completion of this contract.
- B. The project will include the removal and scrap of the existing AGSE at HOU and IAH.

## 1.7 PROGRESS SCHEDULE

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. The work under this Contract shall be complete as specified below.
- C. The new GPUs shall be delivered, installed, and commissioned no later than date specified in the Contract documents.
- D. Within fifteen (15) days after the Notice to Proceed is issued to the Contractor, the Contractor shall submit to Owner an acceptable Progress Schedule of Project activities; including at a minimum:
  - 1. Design, Engineering, Preparation, and Submittal of all Shop Drawings. Note – Shop Drawings are inclusive of ALL submittal requirements, as set forth in these Specifications.
  - 2. Owner's review and approval of Shop Drawings
  - 3. Material Procurement
  - 4. Manufacture of GPUs
  - 5. Contractor's Factory Tests
  - 6. Factory Tests to be witnessed by Owner, at Owner's discretion

7. Shipping and Delivery
  8. Removal and Scrap of Existing GPUs (when applicable)
  9. Installation, testing, and commissioning of new AGSE
- E. The Progress Schedule shall be in Gantt Chart format and be developed utilizing MS Projects Software or other Project Scheduling Software approved by the Owner.
- F. The Progress Schedule will be acceptable to Owner if it provides an orderly progression of the submittals, tests, and deliveries to completion within the specified Milestones and the Contract Times. Such acceptance will not impose on Owner responsibility for the progress schedule, for sequencing, scheduling, or progress of the work nor interfere with or relieve Contractor from Contractor's full responsibility, therefore. Such acceptance shall not be deemed to acknowledge the reasonableness and attainability of the schedule.

#### 1.8 SHIPPING AND DELIVERY

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. Contractor shall select the carrier and bear all costs of packaging, transportation, insurance, special handling, and any other costs associated with shipment and delivery.
- C. Contractor shall deliver the new AGSE, F.O.B. Point of Destination, in accordance with the Contract Times set forth in the Contract Documents, or other date agreed to by Owner and Contractor.
- D. Contractor shall provide written notice to Owner at least fifteen (15) days before shipment of the manner of shipment and the anticipated delivery date. Contractor shall also require the carrier to give Owner at least twenty-four (24) hours' notice by telephone prior to the anticipated hour of delivery.
- E. Delivery shall be made to:
1. HOU
  2. IAH

#### 1.9 PROJECT MEETINGS AND COORDINATION

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.

- B. The Contractor's Project Manager shall schedule, attend, and conduct such Project Meetings as required to:
  - 1. Ensure the Project is executed successfully.
  - 2. Ensure that all parties are fully informed of Project requirements, issues, conflicts, clarifications, interpretations, etc.
  - 3. Resolve any discrepancies or disputes between the Owner and the Contractor.
- C. Travel and per diem costs for any of the Contractor's or their subcontractor's personnel required to travel to HOU or IAH, in any capacity, associated with the Project, and shall be the sole responsibility of the Contractor.
- D. The Contractor's Project Manager shall issue a Monthly Project Status Report to the Owner's designated representative by the fifth (5th) day of each month. This Status report shall include at a minimum, but is not limited to:
  - 1. Current progress against the Contractor's Schedule.
  - 2. Current status of all Contractor Submittals.
  - 3. Any open, unresolved issues or clarifications the Contractor is awaiting a response from the Owner.

#### 1.10 TRAINING

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. The Contractor shall provide separate AGSE Operations and Maintenance classes. These classes will be conducted on-site and shall occur prior to Final Acceptance of the equipment installation.
- C. There shall be a minimum of two AGSE Operations classes which shall include a classroom training course followed by a field training course including allowing each attendee to operate the AGSE and ask questions related to the operations.
- D. There shall be a minimum of one AGSE Maintenance class which shall include a classroom training course followed by a field training course including allowing each attendee to see typical maintenance activities and ask questions related to the maintenance.
- E. Contractor shall submit a Training Syllabus for all training classes to be conducted within thirty (30) days of the Notice to Proceed. Format and content of Contractor's proposed Training classes shall be subject to approval of the Owner.

### 1.11 SPARE PARTS

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. The Contractor shall provide a recommended spare parts list for spare parts that may be required during first two years of normal operation of the AGSE. This recommended Spare Parts List shall be provided prior to the shipment of the new AGSE.
- C. This recommended spare parts lists shall include the manufacturer's item description, part number, assemblies per unit, the recommended on-hand stocking level, and the current list price.

### 1.12 WARRANTY

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. Contractor warrants and guarantees to Owner that the title to new AGSE conveyed shall be proper, its transfer rightful, and free from any security interest, lien, or other encumbrance.
- C. Contractor warrants and guarantees to Owner that the new AGSE conforms to the requirements of the Contract Documents, including this Specification and any samples and Shop Drawings approved by Owner.
- D. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
  - 1. abuse, improper modification or improper maintenance or operation by persons other than Contractor; or
  - 2. normal wear and tear under normal usage.
- E. Contractor's obligation to furnish the new AGSE in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of new AGSE that are non-conforming, or a release of Contractor's obligation to furnish the new AGSE in accordance with the Contract Documents:
  - 1. observations by Owner;
  - 2. recommendation by Owner or payment by Owner of any progress or final payment;
  - 3. use of the new AGSE by Owner;
  - 4. any acceptance by Owner or any failure to do so;
  - 5. the issuance of a Final Acceptance notice by Owner; or

6. any inspection, test or approval by Owner or Owner's representatives.
- F. Owner shall within a reasonable time notify Contractor of any breach of Contractor's warranties or guarantees. If Owner receives notice of a suit or claim as a result of such breach, Owner also may give Contractor notice in writing to defend such suit or claim. If Contractor fails to defend such suit or claim, Contractor will be bound in any subsequent suit or claim against Contractor by Owner by any factual determination in the prior suit.
- G. The Contractor warrants to the Owner that all materials (namely the new AGSE) furnished under this Contract shall be of good quality, free from faults and defects and in conformance with Contract requirements. Any work not so conforming to these standards may be considered defective. If, within one (1) year after the date of Owner's final acceptance of the work, the new AGSE are found to be defective or not in accordance with Contract requirements, the Contractor shall correct it at no cost to the Owner within five (5) days after receipt of written notice from the Owner to do so.
- H. For any new GPUs supplied for this Project, the Contractor shall provide:
  1. An extended 2-year Warranty from final acceptance agreeing to replace, repair, or restore any defective materials and workmanship of the AGSE.
  2. An extended 5-year warranty from final acceptance agreeing to replace, repair, or restore any GPU bus capacitors.
  3. These extended warranties shall be in addition to, and not a limitation of, other rights the Owner may have against the Contractor under the Contract Documents.
- I. The Contractor shall supply Warranty Certificates, in favor of the Owner for all AGSE supplied under this Contract. Such Warranty Certificates shall be supplied with the Final Payment Application.
- J. The Contractor shall supply the Manufacturer's Warranty Certificates, in favor of the Owner, for all new AGSE supplied under this Contract. Such Warranty Certificates shall be supplied with the Final Payment Application.
- K. The Warranty obligations of the Contractor defined herein shall not be limited by any obligations otherwise prescribed by law.
- L. Upon Final Acceptance of the new AGSE, the Contractor shall furnish a good and sufficient Warranty / Maintenance Bond, in the sum of not less than 100% of the Contract amount, guaranteeing that that Contractor will faithfully fulfill the Warranty obligations of the Contract. Such bond shall remain in effect at least one year after the date of final acceptance, except as required by additional warranty and guarantee periods stipulated by Laws or Regulations.
- M. The Warranty / Maintenance Bond shall be executed by a Surety:
  1. Satisfactory to the Owner
  2. Licensed to conduct business in the State of Texas



3. Named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 by the Financial Management Service, Surety Bond Branch, and U.S. Department of the Treasury.
- N. Bonds signed by an agent must be accompanied by a certified copy of such agent's authority to act.
- O. The bonds, along with appropriate Power of Attorney, shall be delivered to Owner, but in no event shall these documents be delivered to the Owner later than fifteen (15) days from the date of Final Acceptance of the AGSE. If, at any time after the execution of the Warranty / Maintenance Bond as above required, Owner shall deem the surety or sureties upon such bond to be unsatisfactory, or if, for any reasons, such bond ceases to be adequate to cover the performance of the Warranty, Contractor shall, at its expense within five (5) days written notice from the Owner to do so, furnish additional bond or bonds in such form and amount and with such surety or sureties as shall be satisfactory to the Owner.
- P. If the Surety on a bond is declared bankrupt or becomes insolvent or its right to do business in the State of Texas or it ceases to meet the requirements of the Warranty clauses stated above, the Contractor shall provide another bond and Surety which comply with those requirements within 5 days, at Contractor's expense.

#### 1.13 MANUALS

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. One searchable electronic and three (3) copies of the new AGSE OEM's O&M manuals shall be provided prior to the AGSE O&M training.

#### 1.14 MATERIALS

- A. Unless otherwise indicated, it is understood and agreed that ANY materials used or otherwise incorporated into the installation of the AGSE or in the manufacture of the AGSE by the Contractor shall be NEW and UNUSED. If required by the Owner, the Contractor will furnish satisfactory evidence as to the kind and quality of materials and equipment.
- B. Whenever an item of material or equipment to be incorporated into the new AGSE is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Contractor or manufacturer, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, other items of material or equipment or material or equipment of other suppliers or manufacturers may be submitted to Owner for review and approval.

1. If in Owner's sole discretion, such an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related work will be required, it may be considered by Owner as an "or equal" item.
  2. For the purposes of this clause, a proposed item of material or equipment may be considered functionally equal to an item so named if:
    - a. in the exercise of reasonable judgment, Owner determines that:
      - 1) it is at least equal in quality, durability, appearance, strength, and design characteristics; and
      - 2) it will reliably perform at least equally well the function imposed by the design concept of the completed Project as a functioning whole; and
    - b. Contractor certifies that:
      - 1) there is no increase in any cost including capital, installation or operating to Owner; and
      - 2) the proposed item will conform substantially, even with deviations, to the detailed requirements of the item named in the Contract Documents.
- C. The Owner will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Paragraph 2 above. Owner will be the sole judge of acceptability. No "or equal" will be ordered, manufactured, or utilized until Owner's review is complete, which will be evidenced by an approved Shop Drawing. Owner will advise Contractor in writing of any negative determination. Notwithstanding Owner's approval of an "or equal" item, Contractor shall remain obligated to comply with the requirements of the Contract Documents.
- D. The Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any such proposed "or-equal."
- E. Contractor shall provide all data in support of any such proposed "or equal" at Contractor's expense.

#### 1.15 APPLICABLE CODES AND STANDARDS

- A. The GPU and all of the accessories and mounting brackets and hardware shall be designed and manufactured to meet U.S. Codes and Regulations that have been adopted by the Aircraft Ground Power Unit industry. Portions or all of certain recognized industry or association standards referred to herein as being a requirement of these Specifications shall be considered as binding as though the reproduced in full herein unless supplemented and/or modified by more stringent requirements in this Specification. Unless otherwise stated, the reference standard shall be the standard which is current as of the date of issuance of these Specifications.

B. Applicable Industry and Association Standards:

1. Directives and Memoranda of the Department of Buildings
2. Americans with Disabilities Act (ADA)
3. MIL-STD-704 Aircraft Electrical Power Characteristics
4. MIL-STD-461 Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference
5. NFPA 70 National Electrical Code (NEC)
6. ANSI C2 National Electrical Safety Code
7. Institute of Electrical and Electronic Engineers (IEEE) 127 and 519
8. ARP-5015 SAE 400 Hertz Ground Power Performance
9. DFS-400 (EURO-STANDARD 400 Hz)
10. Canadian Standards Association (CSA)
11. ICS 6-78 (NEMA) Enclosures for Industrial Control Devices and Systems
12. ST 20 (NEMA) Dry Type Transformers for General Applications
13. ICS-1 General Standards for Industrial Control and Systems
14. ANSI C84.1 Voltage Ratings for Electrical Power Systems and Equipment
15. ATA-101 Ground Equipment Technical Data
16. ISO-1540 Aerospace Characteristics of Aircraft Electrical Systems
17. ISO-6858 Aircraft Ground Support Electrical Supplies
18. IEC 201-1 Electrical Equipment of Industrial Machines
19. MIL-S-19500 Semiconductor Devices
20. MIL-STD-461 Electromagnetic Interference Characteristics, Requirements for Equipment
21. MIL-STD-462 Electromagnetic Interference Characteristics, Measurement of IEC 146 Semiconductor converters
22. ARP-1940 Solid State Frequency Converters
23. MIL-W-16878 Wire, Electrical Insulated, General Specification for UL 489 Circuit Breakers, Molded Case and Circuit Breaker Enclosures.
24. NEMA - National Electrical Manufacturer's Association
25. Houston Airport System (HAS) Design Standards Manual

## 1.16 SUBMITTALS

- A. Bid-Submittals: The following submittals shall be included with bid.
  - 1. Alternates.
  - 2. Spare Parts List: Provide manufacturer's recommended spare parts list.
  - 3. UL Certifications.
  
- B. Pre-Manufacture Submittals: The following submittals shall be made as necessary to meet the project schedule and shall be submitted and approved prior to manufacturing the GPU units.
  - 1. Product data for selected models including specialties and accessories.
  - 2. Shop Drawings: Provide schematics and interconnection diagrams, indicate front and side views of enclosures with overall dimensions and weights shown; conduit/cable entrance locations and requirements; and nameplate legends. Differentiate between manufacturer-installed wiring and field-installed connections.
  - 3. Installation Details: Provide complete installation details including, without limitation, installation details of all appurtenances. Show installed configuration as well as any pertinent details regarding interface to other equipment and systems, include electrical connection service points.
  - 4. Resume or CV of manufacturers project manager.
  
- C. Pre-Ship Submittals: The following shall be submitted and approved prior to shipping GPU units to the project site:
  - 1. Factory Acceptance Testing Reports: Indicate factory acceptance tests and results and inspection procedures.
  - 1. Installation Subcontractor and resume or CV of Installation Site Manager.
  - 2. Written Notice to Owner of scheduled delivery date and time at least 15 days prior to shipment.
  
- D. Pre-Substantial Completion Submittals: The following submittals shall be submitted and approved prior to 14 days before substantial completion, unless otherwise noted herein.
  - 1. Operation and Maintenance Manuals.
  - 2. Training Program: At least 60 days prior to substantial completion, a training program summary, course syllabus, instructor qualifications, and copy of the training manual shall be submitted for review and approval.
  - 3. On-Site Functional Testing Report: Submit proposed on-site functional testing report for approval.

- E. Pre-Final Acceptance Submittals: The following submittals shall be submitted and approved prior to 14 days before final acceptance.
1. As-Built Drawings. Provide field edited redlined project drawings showing deviations from design documents.
  2. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and have been registered with the manufacturer.
  3. On-Site Functional Testing Report: A completed field on-site functional testing report for each installed unit as specified herein. Utilize approved form.
  4. Training Rosters. Provide training roster with trainee names, dates, and types of training, as well as durations.
  5. Original software and documentation registered in the Owner's name.
  6. Hard copy and electronic version (compact disk or flash card) copies of all programs and settings loaded into equipment provided hereunder.

#### 1.17 AIRCRAFT MIX

- A. The GPUs must be capable of servicing the aircraft mix as identified in the Project Drawings.

#### 1.18 INPUT POWER

- A. Input Voltage Rating: 480 Volts (nominal), +/-10%, 3-phase, 3-wire plus ground.
- B. Frequency: 60 Hertz, +/- 5%.
- C. Full Load Amperage:
1. Single Output, 90 KVA Model: 100 amps, maximum.
  2. Dual Output, 180 KVA Model: 200 amps, maximum.
- D. Input Power Factor: Unit shall be rated at a minimum of 0.95 power factor at 480 volts and loads of 25% or greater.
- E. Phase Rotation: Any/or, with automatic phase lock for ABC (CBA) input phase rotation or protection and indication for out of phase condition
- F. Inrush Current: Shall not exceed 100% of the input current required when unit is operating at rated load output.
- G. Line Current Balance: From 10% to rated load, the input line current shall not differ by more than 5% from the arithmetic average current in the three (3) input lines.

- H. Harmonic Distortion of Input Current Wave Form: 6 percent THD maximum over load rating of unit.

#### 1.19 OUTPUT POWER – 400HZ AC

- A. Single Output Rating: 90 KVA continuous at 0.8 power factor, lagging.
- B. Dual Output Rating: 180 KVA continuous at 0.8 power factor, lagging.
- C. Output Voltage: 118/204 Volts RMS, adjustable over a minimum range of +/- 10%, 3-phase, wye, 4-wire, grounded neutral in accordance with the international aircraft electrical power requirements.
- D. Phase Voltage Displacement: The phase angle between each of the three output phases will be 120 degrees +/- 1.5 degrees under all rated balanced loads. The phase angle displacement with a maximum unbalanced load of 15% shall be 120 +/- 4.0 degrees.
- E. Frequency: 400 Hertz +/- 0.1% and shall not be affected by load.
- F. With the SSFC operating at a constant load, a change in ambient temperature up to 55 degrees C in an eight (8) hour period, or as the SSFC stabilizes from cold condition at any load, shall not cause the voltage to change by more than 1% of its rated values.
- G. Voltage Waveform Discontinuities: There shall be no evident discontinuities, spikes, or notches in the waveform when viewed on a high frequency oscilloscope.
- H. Harmonic Distortion: Output voltage waveform shall not exceed 3% (THD) when measured line-to-line and line-to neutral from no load to and including full rated load. Any single harmonic shall not exceed 2% of the fundamental at steady state voltage.
- I. Efficiency: Shall be not less than 90% at any load. No load losses shall not exceed 0.5% of rated load.
- J. Voltage Recovery: When initially operating at rated input frequency and rated voltage, and following any sudden change in load of up to 100% of rated load, the transient output voltage shall not deviate beyond the limits of MIL-STD-704F.
- K. Voltage Phase Balance: The maximum phase voltage imbalance shall not exceed 3.0V rms, with any applied load from no load up to converter's overload rating. Maximum imbalanced loads shall be limited to within the limitations set forth in MIL-STD-704F.
- L. Voltage Modulation: Shall not exceed 0.5% at any steady state condition from no load up to and including 100% of the unit's rated KVA.
- M. Voltage Regulation: Shall not exceed 1% of rated voltage from no load to rated load and from rated load to no load. This regulation shall be maintained with the input line voltage variations of +/- 10%.

- N. Voltage Trim Adjustment: The output voltage trim adjustment shall be +/- 15% of nominal output span.
- O. Overload Capacity: Shall be capable of supplying overloads of up to 115% of rated load continuously, for up to 150% of rated load for five (5) minutes, and for up to 200% of rated load for 10 seconds while maintaining the output voltage within the regulation band.
- P. Line Drop Compensation: Shall be 0 to 5% of voltage span and shall be adjustable.
- Q. Crest Factor: Shall be 1.414, +/- 0.5%.
- R. Frequency Modulation: <+/- 0.10% of the period of output voltage wave, unaffected by load.
- S. DC content shall not exceed 100 millivolts, under any load condition.

#### 1.20 CABLE RETRIEVAL SYSTEM

- A. The 400 Hz system shall be designed with a limit switch for cable fully in and a separate one for cable fully out. The switch for "fully out" shall prevent any further extension of the cable. The retrieval of the cable shall be stopped mechanically by a heavy ring bracket fitted at the "fully in" position on the cable. To prevent any damage, the VFD shall be operated at reduced torque before the "fully in position" is reached. The retrieval command shall automatically stop shortly thereafter. The "in" limit switch shall be used for time-out supervision and PBB Interlock.
- B. The VFD shall be set up with overload protection.
- C. The 400 Hz system shall be designed with a third limit switch that shall be activated whenever there is only 4 m of 400 Hz cable outside the cable drum. At this limit, any further cable retrieval shall automatically take place at a reduced speed. To prevent the operator from dragging the 400 Hz cable connector along the apron as long as the coiling is taking place, it shall not be possible for the operator to activate the coiling operation from the remote control station until this limit switch is activated.
- D. There shall be an "Emergency Rollout" circuit which will rapidly release any remaining cable from the cable drum when actuated. This will allow the PBB to be moved away from the aircraft without disconnecting the power from the unit, in the case of a fire in the building or PBB.

#### 1.21 OVERLOAD

- A. Overload Capacity: The GPU shall be capable of supplying overloads of up to 125% for 10 minutes, 150% for 30 seconds and 200% for 10 seconds.
- B. Short Circuit Capability: The GPU shall withstand an output short and the short shall be cleared by internal solid-state circuitry.

## 1.22 FAULT SYSTEMS

- A. The GPU will be capable of monitoring the following items and shutting down in the event they are out of tolerance. The faults listed below will be displayed.
1. Input voltage 10% higher than nominal rating
  2. Input voltage 15% less than nominal rating
  3. Output voltage less than 100 Vac per MIL-STD-704E
  4. Output voltage greater than 125 Vac per MIL-STD-704E
  5. Output overload
  6. No 28vdc returned on EF wires
  7. EF wire voltage greater than 60v
  8. DC bus faults
  9. Over temperature of heat sink
  10. Output frequency fault
- B. The GPU shall be capable of performing a “self-check” of the output power quality before allowing power to be supplied to the aircraft.

## 1.23 INDICATORS

- A. The GPU shall display the following information using an LCD or LED or via downloading to the Owner’s laptop PC via an RS232 port. If the use of an RS232 port interface is required, the Contractor shall supply the necessary cables and software to connect to the Owner’s laptop to the GPU, retrieve and display the required data.
1. Input voltage – each phase and average
  2. Input current – 3 phase average
  3. Output voltage – each phase and average
  4. Output current – each phase and average
  5. Output kVA (total) or Vdc (total)
  6. Output frequency
  7. Event History.
  8. Unit Settings
- B. Front panel lights will indicate the following:
1. Fault occurred



2. Input voltage applied to unit
3. 28Vdc bypass switch in bypass position
4. Output voltage present, unit is connected to aircraft and operating
5. 28Vdc EF voltage missing

#### 1.24 SWITCHES AND CONTROLS

- A. The GPU and Cable Hoist shall be controlled by a single Pendant Control mounted near the wheel bogie of the PLB.
  1. The Pendant Control shall NOT be mounted on any part of the PLB that elevates or in a location that which would pose a safety hazard to ramp personnel using the pendant control.
  2. Pendant control for the GPU / Cable Hoist shall be mounted on a plate attached to the wheel bogie cross tube and painted per the paint process specified for the PLB exterior. The color shall match the PLB color. The PCA pendant control could also be mounted to this plate.
- B. All voltages in the Pendant Control shall be low voltage – 28 volts maximum.
- C. The Pendant Control shall comply with the following.
  1. All wiring shall be identified using stamped wire or other Owner approved wire labels. If stamped wires are used, number must be visible at termination point. Wires are to be numbered in a logical sequence and all wire numbers are to be indicated on electrical schematics.
  2. Spare wires shall be numbered and also labeled as "SPARE". Spare wires shall be indicated on the electrical schematics.
  3. All wires, including spares, within Pendant Control shall be neatly secured and routed. Wire routing trays shall be used when interior space permits.
  4. All wiring shall be brought to terminal blocks. The wiring shall be formed and restrained to give a neat appearance. Wire splices of any type shall NOT be used. Terminals must meet the applicable requirements of SAE J561, J858, and J928. Wires must meet the bend radius requirements of NEC. Ninety-degree bends shall not be allowed.
  5. Terminal blocks shall be of finger proof or tamper proof design or shall have a protective cover supplied by the terminal block manufacturer.
  6. Grommets and suitable anti-chafe material shall be used where wires are required to pass through structure or similar relief or opening which exposes the wire to possible chafing.

7. Quick Disconnect fittings must be MS standard receptacles and plugs and shall be UL or ETL approved. Quick Disconnect receptacles and plugs shall be labeled with a permanent type label to indicate which receptacle goes with which plug.
  8. Wire ties SHALL NOT be used to securing any wiring. NEC / UL approved clamps and methods must be used to secure wiring.
- D. Pendant control enclosures shall be SST and NEMA rated weatherproof. Cover plate shall have self-retaining screws and shall have a means to allow water to drain from the bottom of the enclosure. Alternately, a NEMA-4 rated, poly-coated painted steel enclosure without holes or drain devices for condensate is acceptable.
- E. Pendant Control shall be standard 90SX240 pendant control box with LED HD control screen or equal. The pendant control shall have the following buttons and indicators for the 400HZ GPU functions. If push buttons are provided, the buttons and indicators shall be oriented from top to bottom in the pendant control in the order listed below.
1. 'CABLE IN' normally open push button
  2. 'CABLE OUT' normally open push button
  3. Output status LED: Green – Output 1 ON
  4. 'START' normally open push button
  5. 'STOP/RESET' normally open push button
- F. If a LED control screen is not provided, each button on the Pendant control or indicator shall be labeled with an engraved placard identifying the button or indicator function.
- G. In addition to the Pendant Control, the following controls and indicators shall be located on the outside of the GPU unit:
1. Power ON LED – Blue
  2. Warning LED – Yellow when active
  3. Alarm/Failure LED – Red when active
  4. Display Navigation buttons (Up, Down, Left, Right & Select)
  5. Output - 400 Hz Power On/Off/Reset pushbutton.
  6. Output status LED: Green – Output 1 ON
  7. Emergency Stop, Normally Closed, pushbutton
  8. Eleven-Line 40 character alphanumeric display with pushbutton controls for changing screens and entering values.
    - a. Display – Information provided at the LCD shall ease the operation of the 400 Hz System and facilitate service and maintenance work. Such information shall be appropriately segregated into the following modes.

- 1) Default Mode: shall show the status of the 400 Hz system and its different functioning parameters including output voltage, current, frequency and power information on multiple screens. Display system voltages, temperature, software versions and MAC address on multiple screens. Display current status of all inputs and outputs to the controller.
  - 2) Alarm mode: shall show records of error occurrence resulting in an alarm, including history of previous errors up to at least the last 50 records.
  - 3) Power Log Mode: shall show records in terms of date, time and power consumption in which the 400 Hz system was in operation, including the history of previous usage up to the last 50 records
  - 4) Setup mode: shall allow the operator / technician to change the functional parameters of the 400 Hz system. This mode shall also be protected by a password or some other means of preventing unauthorized personal from changing any of the functional parameters:
- H. In addition to the Pendant Control, the following controls and indicators shall be located on the inside of the GPU unit:
1. Line drop compensation adjustment
  2. Voltage adjustment ( $\pm 10\%$ )
  3. Hour meter (99,999 hours)

#### 1.25 EXTERNAL INTERFACE

- A. The GPU shall contain either a) externally pluggable connectors or b) internally mounted terminal blocks for the GPU Pendant Control and PLB Interlock.
- B. Internally mounted terminal blocks shall be used for connecting the GPU output cable and any control functions from the GPU output cable, pendant control or PLB interlock. All connection points shall be clearly labeled as to the function that will connect to them from the GPU output cable, pendant control and PLB interlock. The terminal blocks for the GPU output cables shall be "stud" type.
- C. The GPU shall be mounted under the PLB Cab Bubble or PLB C Tunnel as close to the PLB Cab Bubble as possible.
- D. The GPU shall have yellow and black safety tape applied to the bottom circumference of the GPU.

#### 1.26 PHYSICAL CHARACTERISTICS

- A. Cabinet Dimensions: The GPU shall be mountable either under the Cab of the PLB or on the side of the PLB

- B. Cabinet Material: The cabinet will be constructed from painted anodized aluminum or steel enclosure that is degreased, iron phosphate, dried and powder coated with primer and finish coat over 60µm each coat for corrosion protection. Color will be Manufacturer's standard color.
- C. Weather Rating: The GPU's cabinet / enclosure shall be rated as NEMA 3R or IEC IP54.
- D. Wiring: All internal and external wires or cables shall be numbered or labeled.
- E. Connectors: All connectors shall be unique to the point of connections on the boards
- F. Terminal Blocks: All wire splicing and connections shall be accomplished on terminal blocks. Wire splicing, twist connectors, etc. shall not be permitted.
- G. Acoustical Noise: The GPU shall not emit more than 70 dBA at 1.5 meter height and 1.0 meter distant.
- H. Temperature Rating: The GPU shall be capable of operating temperature of -40 to +55 degrees C.

#### 1.27 OTHER DESIGN REQUIREMENTS

- A. The main enclosure shall be designed around a surface treated welded steel frame and shall consist of 3 compartments, one which houses the 400Hz cable and cable drum, one which houses the transformers, output contactors and output filter capacitors and the last which houses the Printed Circuit Boards (PCBs) and all other power electronics.
- B. Vertical cooling towers or heat sink shall be utilized to cool sensitive internal electronic components.
- C. Cooling Fans shall cool the cooling tower or heat sinks. Any fans that circulate air into the interior of the GPU must utilize input air that is filtered. The filters shall be easily accessible and removable for cleaning. The filters shall be a washable mesh type.
- D. Interior of the unit shall be sealed so that contaminants brought into the unit by cooling fans will not enter the control sections of the unit.
- E. The GPU shall be designed so that all the maintenance, including removal and installation of all components can be accomplished without removing the GPU from the Passenger Loading Bridge.
- F. GPU shall be interlocked with the PLB to prevent horizontal movement of the PLB if the GPU unit is powered on.
- G. Control Boards.
  - 1. All control boards must be mounted in a card rack OR a board specific location.

2. All connection to the boards shall be accomplished by plug in connectors
3. Each connector must be unique to its point of connection to eliminate misconnections
4. Each connector shall be labeled along with all its wire connections

H. Wiring and Terminal Blocks

1. Wires shall not be pulled tight in the GPU unit or subjected to chafing or damage by vibration of the GPU or by the operation of the PLB. Wires shall not droop or sag in their routing.
2. All wiring shall be brought to terminal blocks.
3. Wire splices of any type shall NOT be used.
4. Wiring shall be formed and restrained to give a neat appearance.
5. All wires, including spares, within junction boxes, control cabinets, disconnects, other electrical enclosures shall be neatly secured and routed. Wire routing trays shall be used when interior space permits.
6. All wiring shall be identified using stamped labels or other Owner approved wire labels.
  - a. Labels shall be visible and located within 1 in. of their termination point.
  - b. Wires are to be numbered in a logical sequence and all wire numbers are to be indicated on electrical schematics.
7. Spare wires shall be numbered and also labeled as "SPARE". Spare wires shall be indicated on the electrical schematics.
8. Wires must meet the bend radius requirements of NEC. Ninety-degree bends shall not be allowed.
9. Ferrules or insulated ring terminals shall be used on any fine stranded wire, depending on the terminal block connection.
  - a. Fork or Spade terminals shall NOT be allowed.
  - b. Direct connection of fine stranded wire to a terminal block shall NOT be allowed.
10. Terminal blocks shall be either:
  - a. Finger proof or tamper proof design
  - b. Stud or open style design with a protective cover supplied by the terminal block manufacturer.
11. Other terminal block designs shall not be accepted.
12. Terminal blocks must meet the applicable requirements of SAE J561, J858, and J928.

- I. Wire ties SHALL NOT be used to securing any wiring. NEC / UL approved clamps and methods must be used to secure wiring.
- J. Grommets and suitable anti-chafe material shall be used where wires are required to pass through structure or similar relief or opening which exposes the wire to possible chafing.
- K. The front and rear door of GPU shall be hinged or lift off to allow for maintenance and equipped with a door interlock switch that trips the unit's main shunt trip breaker when opened. The door interlock must be able to be by-passed for maintenance access to the unit.
- L. The front and rear door of GPU shall be lockable to prevent unauthorized access into the unit. There shall be two lockable latches on each door, on either side of the door.
- M. The GPU shall be able to provide the required signal to the PLB and provide a suitable connection for the interlock wiring.
- N. Attached to the interior of the GPU's front door shall be a:
  - 1. laminated drawing which provides an elevation view of the front internal compartment of the GPU and identifies each component's location, as well as the component description and manufacture's part number.
  - 2. wiring schematic showing all the wires by wire number and termination point for connections visible from the front of the unit.
- O. Attached to the interior of the GPU's rear door shall be a:
  - 1. laminated drawing which provides an elevation view of the rear internal compartment of the GPU and identifies each component's location, as well as the component description and manufacture's part number.
  - 2. wiring schematic showing all the wires by wire number and termination point for connections visible from the rear of the unit.
- P. If the GPU's front and / or rear doors are equipped with electrical controls or components, the doors shall be equipped with grounding straps.
  - 1. Grounding straps used on the GPU shall be braided. Wire type straps shall not be allowed.
- Q. The GPU shall be equipped with a desiccant filter or other means of removing moisture from the sections of the GPU containing the circuit boards.
- R. An unused holes or penetrations in the exterior of the GPU shall be plugged. If the holes are threaded, SST bolts shall be used to plug the hole.
- S. The GPU shall have an exterior paint system that provides superior corrosion protection. Exterior casing surfaces, doors, panels shall be primed and have a baked enamel finish coat. Color shall match the color selected by the Owner for the PLB.

- T. Mounting brackets used to attach the GPU to the PLB shall be painted per the paint process specified for the PLB exterior. The color shall match the PLB color.
- U. Power cables shall be high temperature (125 °C) and halogen free. Termination shall be with compression type cable lugs / bolts and secured with leaf springs washers. The minimum size of cables used within the unit shall be 1 mm<sup>2</sup> with the exception of PCB and ribbon cables. Control terminals and small power terminals shall be of the clamp type capable of taking up to 4 mm<sup>2</sup> flexible core. All cables shall be clearly marked near termination points at both ends, using an indelible method (e.g. slip-on type markers). Wrap-around adhesive markers shall not be accepted. The marking/numbering shall correspond with schematics / diagrams.
- V. Cable drum construction:
1. The cable drum shall be made of a hollow drum with a spiral trace sufficiently long enough to hold the entire length of the 400 Hz cable installed.
  2. To ensure as low a stress as possible on the cable, the cable drum axis shall be horizontally oriented.
  3. The drum axle shall be supported at both ends with bearings.
  4. The diameter of the drum shall suit the minimum bending radius of the 400 Hz cable.
  5. The cable shall be coiled with the turns side by side to achieve a constant coiling speed, maintaining the same coiling radius and avoiding excessive heat development when the 400 Hz system is operating without the cable fully uncoiled.
  6. Rollers shall be installed along the circumference of the cable drum to secure smooth movement and minimum stress on the cable when it is coiled out.
  7. The driving system of the cable drum shall consist of an electrically operated gear motor with Variable Frequency Drive (VFD) for soft-start and smooth operation and a closed transmission casing between the gear motor and the drum.
  8. A robust cable guide system shall be provided to ensure smooth and precise movement of the cable. The cable guide shall consist of a sledge, driven by the spiral trace on the cable drum. It shall be equipped with rollers to minimize mechanical stress on the 400 Hz cable.
  9. It shall be possible to coil the 400 Hz cable in and out without any obstruction resulting in jamming of the cable.
  10. The system shall be designed in order that the operator doesn't have to guide nor pull the 400 Hz cable in any way when the cable is coiled in or out.
  11. The cable retriever system shall be designed with a special twistable and highly flexible cable harness for power transfer from the output of the solid-state frequency converter to the rotating cable drum. Slip rings or other devices for power transfer shall not be allowed.

### 1.28 ADJUSTING

- A. Adjust line drop compensation to operate with length of aircraft cable installed. Proper test equipment shall be utilized to verify adjustment of line drop compensation circuit.
- B. Operational Voltages: 1.
  - 1. 400 Hz:
    - a. No Load Voltage: 116.0 - 117.0 Volts
    - b. Full Load Voltage: 115.0 - 116.5 Volts

### 1.29 CERTIFICATIONS

- A. The GPU shall be certified by a NRTL for compliance to UL-1012 and CSA-C22.2 No. 107.1-01. Evidence of such certification must be supplied with the Contractor's Proposal.
- B. The GPU shall also have an NRTL certification name plate affixed to the GPU.

### 1.30 FACTORY ACCEPTANCE TESTING

- A. Contractor's Factory Testing Plan
  - 1. The Contractor and/or new equipment Manufacturer shall develop a Factory Testing Plan, as part of its overall Quality Plan, which identifies the specific testing to be done at the Contractor's and/or new equipment Manufacturer's factory. The Factory Tests must confirm, to the extent possible in Contractor's and/or new equipment Manufacturer's factory that all features, functions and capabilities of the AGSE, as defined in the Specification and Contract Documents, are performing as intended. The Factory Test Plan shall be submitted with the Contractor's Quality Plan and approved by the Owner thirty (30) days prior to any Factory Tests being conducted.
  - 2. It is the intent of the Owner that the Contractor and/or new equipment Manufacturer shall develop a comprehensive Factory Test Plan, identifying the specifics of the tests to be carried out, and the acceptance criteria of such test, to ensure the AGSE comply with the requirements of the Specification and Contract Documents.
  - 3. Owner or his representative shall have the right to witness these tests, for which purpose a 5-day notification shall be given before performance.
  - 4. Complete test reports shall be submitted within 2 weeks of factory test.
  - 5. The first unit shall be type tested at actual design summer condition for capacity and performance.

### 1.31 ON-SITE FUNCTIONAL TESTING

- A. Contractor's On-Site Testing Plan



1. The Contractor shall develop an On-Site Testing Plan, as part of its overall Quality Plan, which identifies the specific testing to be done by the Contractor after the AGSE are installed at IAH. The On-Site Testing must confirm that all of the AGSE function as intended, alone and in conjunction with each other and provide the required features, functions and capabilities as defined in the Specification and Contract Documents. The On-Site Test Plan shall be submitted with the Contractor's Quality Plan and approved by the Owner thirty (30) days prior to any On-Site Tests being conducted.
2. It is the intent of the Owner that the Contractor shall develop a comprehensive On-Site Test Plan, identifying the specifics of the tests to be carried out, and the acceptance criteria of such test, to ensure the AGSE comply with the requirements of the Specification and Contract Documents.
3. In-Process Field Testing and Inspection: All installed equipment shall be inspected, all wiring checked for proper continuity, and units checked for leaks in accordance with the applicable specs and standards.
4. On-Site Acceptance Tests: Recognizing that it is impractical to simultaneously duplicate the design ambient, aircraft activity, and passenger loads for performing system capacity, acceptance criteria for system rating will be based on certain capacity measurements and interpolation/extrapolation of data. These criteria and procedures will be mutually agreed to by the Supplier and Owner before the performance of the acceptance tests.
5. Following check out and inspection by the Supplier, a complete acceptance test shall be made of each gate system using live aircraft and shall be witnessed by the Owner.
6. Tests shall comprise those in the approved test procedure and should include but not be limited to.
  - a. Operational Checkout:
    - 1) Local and remote pushbuttons shall be checked for operation.
    - 2) Correct phase rotation shall be verified by unit's status indicator.
    - 3) E&F circuit interlock and bypass operation shall be verified by unit's status indicators.
    - 4) Lamp Test shall be verified by unit's status indicators.
  - b. No Load - Operate at no load and nominal input voltage. Measure and record input voltage, output voltage(s), and output frequency at aircraft cable plugs.
  - c. Load Test - Operate 400 Hz unit output at 50%, and 100% loads. Measure and record output voltage at aircraft cable plugs for each load interval.
7. Complete test reports shall be submitted within 10 working days of completion of the actual tests.
8. Test reports shall contain suitable data reduction and calculation to verify the goals of the test plan and the system capacity.

### 1.32 GENERAL QUALITY ASSURANCE REQUIREMENTS

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. The quality assurance requirements for this project shall focus on ensuring Contractor and/or new equipment Manufacturer refurbishes, designs, manufactures, delivers and installs the required equipment that fully complies with the requirements of this Specification.
- C. The quality assurance requirements shall consist of:
  - 1. The Contractor's and/or new equipment Manufacturer's Quality System – Consisting of the Contractor's and/or new equipment Manufacturer's Quality Manual and Quality Procedures
  - 2. The Contractor's and/or new equipment Manufacturer's Quality Plan – The Quality Plan developed by the Contractor and/or new equipment Manufacturer and to ensure all requirements of this Specification are met.
  - 3. Contract Review and Design - The Specification Compliance Document, drawings, cut sheets, calculations, third party certifications, test results, etc. submitted by the Contractor and/or Manufacturer for review and approval of the Owner.
  - 4. Contractor's and/or new equipment Manufacturer's Material Receipt, In-Process Manufacturing and Final Inspections – All receiving, in-process and final inspection documents and reports shall be submitted for review and approval of the Owner.
  - 5. Factory Acceptance Testing – The Contractor and/or new equipment Manufacturer Factory Acceptance Testing to ensure the new AGSE meets the design requirements of this Specification. The Contractor shall submit reports of such acceptance testing for review and approval of the Owner.
  - 6. Owner Inspection prior to Shipment – The Owner reserves the right to perform an in-factory inspection of all equipment PRIOR to shipment. This inspection shall review compliance to the Specifications and to ensure all equipment has passed Factory Acceptance Testing. Witness of certain Factory Acceptance Testing shall also be part of this in-factory inspection. Travel, lodging, per diem and other costs for the Owner's representatives to conduct any subsequent inspections required, should the equipment fail the initial inspection, shall be the responsibility of the Contractor.
  - 7. Contractor's Installation In-Process and Punch List Completion Inspection – All Installation In-Process and Punch List Completion inspection documents and reports shall be submitted for review and approval of the Owner.
  - 8. Owner in Process Installation Inspection – The Owner's representative will perform an in process inspection during the Installation process.
  - 9. Functional Testing – As part of the installation process, the Contractor shall conduct Functional Testing to verify the equipment meets certain functional

requirements of the Specification. All test reports from such Functional Testing shall be submitted to the Owner for review and approval.

10. Owner Final Inspection – The Owner’s representative will perform a final inspection after Final Acceptance is achieved on all equipment. At this time, a Final Punch List will be generated, identifying all non-conformances with the AGSE and Services and the agreed upon date between the Owner and the Contractor for the Contractor to remedy all non-conformances.

### 1.33 CONTRACTOR’S QUALITY PLAN

- A. The Contractor and/or new equipment Manufacturer shall develop a Quality Plan that identifies the relevant inspection points and acceptance criteria that will be utilized by the Contractor and/or new equipment Manufacturer to ensure all requirements of the Specification are met.
- B. The Quality Plan shall identify the inspection and review points during the contract review, design, manufacturing, and installation where the Contractor and/or new equipment Manufacturer will perform inspections or tests to ensure compliance to the Specifications.
- C. The Quality Plan shall identify the scope of the inspections and tests and the specific acceptance criteria that will be utilized by the Contractor and/or new equipment Manufacturer for each inspection and test.
- D. The Quality Plan shall also identify the test plan, procedures, methods, techniques, etc. that will be utilized by the Contractor and/or new equipment Manufacturer to conduct the required FACTORY ACCEPTANCE TESTING and ON-SITE FUNCTIONAL TESTING.
- E. The Contractor and/or the new equipment Manufacturer shall submit their Quality Plan to the Owner for approval within sixty (60) days of the issuance of the Notice to Proceed.

### 1.34 NON-CONFORMING GOODS

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. The Owner has the right to disapprove or reject Goods or Services that the Owner believes to be non-conforming.
- C. If the Owner elects to reject the Goods or Services in whole or in part, Owner’s notice to Contractor will describe in sufficient detail the non-conforming aspect of the Goods or Services. If Goods or Services have been delivered to Owner, Contractor shall promptly, and within the Contract Times, remove and replace or modify the rejected Goods or Services.

- D. Contractor shall bear all costs, losses, and damages attributable to the removal and replacement or modification of the non-conforming Goods or Services.
- E. Upon rejection of the Goods, Owner retains a security interest in the Goods and Services or to the extent of any payments made and expenses incurred in their testing and inspection.
- F. If the Owner elects to permit the Contractor to modify the Goods or Services to remove the non-conformance, Contractor shall promptly provide a schedule for such modifications and shall make the Goods or Services conforming within a reasonable time.
- G. Instead of requiring modification or removal and replacement of non-conforming Goods or Services discovered either before or after final payment, Owner may accept the non-conforming Goods or Services. Contractor shall bear all costs, losses, and damages attributable to Owner's evaluation of and determination to accept such non-conforming Goods or Services.
- H. Contractor shall pay all claims, costs, losses, and damages, including but not limited to all fees and charges for re-inspection, retesting and for any engineers, architects, attorneys and other professionals, and all court or arbitration or other dispute resolution costs arising out of or relating to the non-conforming Goods or Services, including the modification or removal and replacement of the non-conforming Goods or Services and the replacement of property of Owner and others destroyed by the modification or removal and replacement of the non-conforming Goods or Services, or the obtaining of conforming Goods or Services from others.
- I. Contractor's responsibility for correcting all non-conformities in the Goods and Services will extend for the Warranty Period as specified in the Contract Documents after the date of Final Acceptance of the Goods and Services, or for such longer period of time as may be prescribed by Laws or Regulations or by the terms of any specific provisions of the Contract Documents.
- J. Neither payments made by Owner to Contractor prior to any tests or inspections, nor any tests or inspections shall constitute acceptance of non-conforming Goods, or prejudice Owner's rights under the Contract.

### 1.35 INSPECTIONS

- A. Factory Inspections
  - 1. The Owner may conduct a Factory Inspection of the new AGSE at the manufacturing location and perform an inspection of the equipment and witness the AGSE tests as set forth in the specification and in the Contractor's and/or new equipment Manufacturer's approved Factory Test plan.
  - 2. The Owner may send up to three (3) representatives to conduct the Factory Inspections.

3. The Contractor shall supply the Owner's inspection representatives with instruments, tools, and equipment and all such assistance as they may find necessary to conduct inspections of the equipment.
4. Contractor shall provide Owner 30-days written notice, prior to shipment, of the readiness of the AGSE for the Owner's inspection. All the AGSE shall be available for inspection and testing at the same time.
5. The Owner shall arrange and pay for all travel, lodging, local transportation, and local meals for the Owner's representatives attending the factory testing.
6. If, on the basis of the Factory inspections and testing, the AGSE appear to be conforming, Owner will give Contractor prompt notice thereof. If on the basis of the Factory inspection and testing, the AGSE appear to be non-conforming, Owner will give Contractor prompt notice thereof and will advise Contractor of the required remedies and if such remedies must be accomplished prior to shipment and if a subsequent inspection by the Owner's representatives will be required prior to shipment.
7. If subsequent factory inspections will be required, as determined by the Owner, the Contractor shall arrange and pay for all travel, lodging, local transportation, and local meals for the Owner's representatives (up to three (3)) to attend this factory re-inspection and re-testing.

B. Inspection Upon Delivery

1. Contractor shall inspect the AGSE upon delivery solely for purposes of identifying the AGSE and general verification of quantities and observation of apparent condition in order to ensure AGSE are acceptable and suitable for installation. Such inspection will not be construed as final or as receipt of any AGSE and Services that, as a result of subsequent inspections and tests, are determined to be non-conforming.
2. Within three (3) days of such receiving inspections, Contractor shall provide Owner with written notice of Contractor's determination regarding conformity of the AGSE. In the event Contractor does not provide such notice, it will be presumed that the AGSE are suitable for Installation.

C. Inspection During Installation Process

1. The Owner's representative will conduct one or more inspections during the Installation process to review the Contractor's compliance with the Installation Specification and the rectification of any previously identified non-conformities. The Contractor shall supply the Owner's inspection representative with instruments and all such assistance as they may find necessary.
2. The Owner reserves the right to conduct these Installation inspections, unannounced and at any time during the Installation process.
3. If, on the basis of any inspections or testing, the AGSE or Services appear to be non-conforming, Owner will give Contractor prompt notice thereof will advise

Contractor of the required remedies and the required completion date of such remedies.

D. Inspection at Final Acceptance

1. The Owner's representative will conduct a Final Acceptance Inspections when the Contractor has completed the Installation of the AGSE. The Owner's representative shall review all of the AGSE to ensure they are installed properly, that the Services have been completely carried out and that all previously identified non-conformities have been remedied. During this Final Acceptance Inspection, the Contractor shall conduct, with the Owner's representative as a witness, the specified on-site functional testing of the AGSE. The Owner's representative will identify any Punch List items that must be remedied by the Contractor during the Final Acceptance Inspection.
2. The Contractor shall provide seven (7) days written notice to the Owner of the proposed date of Final Acceptance and on-site functional testing.
3. If the AGSE are considered by the Owner to be Substantially Complete and useable for the intended purpose, the Contractor shall issue a Final Acceptance Certificate to the Owner. This Final Acceptance Certificate must list all identified Punch List items, must indicate a due date for the completion of the Punch List items, and must be approved by the Owner.
4. If the Contractor does not receive a signed Final Acceptance Certificate on the required date, as specified in the Contract Documents, the Owner may exercise delay penalties as called out in the Contract Documents.

E. Final Acceptance

1. Once the Contractor has remedied all of the Punch List items, the Owner shall be notified to re-inspect the AGSE and Services. Upon such notification, the Owner's representative shall re-inspect the AGSE and Services to verify the Punch List items have been remedied.
2. If any of the Punch List items have not been remedied to the Owner's satisfaction and subsequent inspections are required by the Owner's representative, the Contractor shall bear any and all costs, including labor, material, travel and per diem, incurred by the Owner to conduct such repeat FINAL ACCEPTANCE inspections.
3. If the Contractor does not remedy the Punch List items by the date identified on the Final Acceptance form, the Owner may exercise delay penalties as called out in the Contract Documents.
4. Once all Punch List items are remedied and accepted by the Owner, the Contractor shall issue a Final Acceptance Certificate, indicating the date the AGSE and Services have been accepted by the Owner. This date will also be the start date of the Contractor's Warranty Period.

END OF SECTION

## SECTION 347713.3 – AIRCRAFT PRE-CONDITIONED AIR UNITS

### 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. Related Requirements and products not supplied under this section:
  - 1. Section 347713.1 Passenger Boarding Bridges
  - 2. Section 347713.2 Aircraft Ground Power Units
  - 3. Section 347713.4 Potable Water Cabinets

#### 1.2 SUMMARY

- A. Work Includes designing, manufacturing, testing, furnishing, installing, and commissioning Point of Use (POU), direct expansion (Dx) Preconditioned Air (PCA) units and associated controls and accessory equipment.
- B. This specification sets forth the description, technical and performance specifications for aircraft pre-conditioned air units (PCA).
  - 1. This specification is intended to include five models which are defined based on aircraft fleet / sub fleet to be serviced. Models shall include:
    - a. Class I: PCA unit shall be single hose units capable of serving the following aircraft: Regional Jets, including but not limited to EMB 145, CRJ-200, CRJ-700 & CRJ- 900.
    - b. Class II: PCA unit shall be single output units capable of serving the following aircraft: ERJ, CRJ, MD 80/90, & B-727 & B-737/3/4/5/6/7/8/9/10.
    - c. Class III: PCA unit shall be single output units capable of serving the following aircraft: ERJ, CRJ, MD 80/90, B-717, B-737/All, B-757/2/3, A319, A320, and A321.
    - d. Class IV: PCA unit shall be dual output units capable of serving the following aircraft: All Class I, II, and III aircraft as well as B-767/2/3/4.
    - e. Class V: PCA unit shall be dual output units capable of serving the following aircraft: All Class I, II, III, and IV aircraft as well as ADG V aircraft and half of the total cooling load associated with the A-380.
- C. Unless noted otherwise on the drawings, the work shall include everything necessary or incidental to complete the installation including wire raceway (conduit), raceway fittings, outlet boxes, pull boxes, terminal cabinets, 120 volt AC power circuits, and



insulated ground cables. Such equipment shall be furnished and installed as Division 26 electrical work. The Contractor shall furnish all necessary information to other contractor(s) to ensure that a proper conduit system will be installed. Provide accurate as-built drawings indicating all installed conduit and junction boxes.

- D. The Contractor shall cooperate with all other contractors engaged in this project and shall coordinate the passenger boarding bridge installation so that all work will proceed in a manner which is in the best interests of the project.
- E. It is the purpose of this specification to require the furnishing of highest quality materials, equipment, and workmanship. The work shall be in accordance with this specification and conform to the designs, layouts, and descriptions on the drawings.

### 1.3 DEFINITIONS

- A. "Aircraft Gate Support Equipment (AGSE)" or "Goods" shall mean various pieces of equipment that the Owner is procuring or supplying for installation for Houston Airport System (HAS). This equipment shall include the following:
  - 1. "PBBs" shall mean the new Passenger Boarding Bridges.
  - 2. "GPU" shall mean the new Ground Power Units.
  - 3. "PCA" shall mean the new aircraft Pre-Conditioned Air Units.
  - 4. "RTU" shall mean the PBBs cooling unit.
- B. The terms "Direct Expansion (Dx), Point-of-Use (POU), Preconditioned Air Unit "PCA Unit", "Unit", and " PCA" as used within this specification, shall be construed to mean the components, sub-components and sub-systems that constitute a complete, operable, and maintainable Direct Expansion, Point-of-Use Preconditioned Air Unit, including all ancillary equipment, such as air hoses, hose couplings, hose storage devices, etc.
- C. "Authority" or "Airport" or "Owner" or "HAS" may be used interchangeably throughout this Specification and shall mean Houston Airport System.
- D. "Bidder" or "Contractor" or "Supplier" or "Offeror" or "Proposer" may be used interchangeably throughout this Specification and shall mean the individual, partnership, corporation, or other business entity that shall be supplying AGSE and Installation Scope of Work pursuant to this Specification.
- E. "HOU": William P. Hobby Airport. "IAH": George Bush Intercontinental Airport.
- F. Drawings - That part of the Contract Documents prepared or approved by the Owner that graphically shows the scope, intent, and character of the AGSE and Services to be furnished by Contractor.
- G. Project: The total undertaking of which the AGSE and Installation Scope of Work to be provided under the Contract are a part.

- H. Samples: Physical examples of materials, equipment, or workmanship that are representative of some portion or all of the AGSE and which establish the standards by which certain portions of the AGSE or Installation Scope of Work will be judged.
- I. Services: The Scope of Work performed at HOU and IAH.
- J. Shop Drawings: All drawings, diagrams, illustrations, schedules, test reports, certifications, cut sheets, calculations and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to demonstrate that the Contractor will provide AGSE and Installation Scope of Work which meet the requirements of the Specifications.
- K. Specifications: Shall mean these Technical Specifications and related Contract Documents.

#### 1.4 INTENT OF CERTAIN TERMS OR ADJECTIVES

- A. The Contract Documents include the terms “as allowed”, “as approved”, “as ordered”, “as directed”, or terms of like effect or import to authorize an exercise of professional judgment by the Owner. In addition, the adjectives “reasonable”, “suitable”, “acceptable”, “proper”, “satisfactory”, or adjectives of like effect or import are used to describe an action or determination of Owner as to the suitability of the Materials used to manufacture new AGSE. It is intended that such exercise of professional judgment, action or determination will be solely to evaluate, in general, the AGSE for compliance with the requirements of and information in the Contract Documents and conformance with the design concept of the completed Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective shall not be effective to assign to Owner any duty or authority to supervise or direct the furnishing of AGSE or any duty or authority to undertake responsibility contrary to any other provision of the Contract Documents.
- B. Unless stated otherwise in the Contract Documents, words or phrases which have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.
- C. The word “non-conforming”, when modifying the word AGSE or Goods, refers to AGSE that fail to conform to the requirements of the Specifications, written Amendments, Change Orders and written clarifications or interpretations issued by the Owner.
- D. The word “day” or “days” shall constitute a calendar day of 24 hours measured from midnight to the next midnight. When a numeric indication is given for a number of “days”, it shall mean calendar days not work weekdays.

## 1.5 GENERAL

- A. The term "Aircraft Pre-Conditioned Air Unit", "Pre-Conditioned Air Unit", and "PCA" as used within this specification and throughout the contract documents is understood to mean the components, subcomponents and subsystems that constitute a complete, operable, and maintainable Aircraft Pre-Conditioned Air Unit and as referred to herein, are synonymous.
- B. The terms, "Seller", "Contractor", "Provider", and "Manufacturer" as referred to herein, are synonymous.
- C. Applicable contract and terminal building drawings will be made available upon written request.
- D. The PCA and all components thereof shall be constructed in accordance with all codes and standards and local laws and regulations applicable to the design and construction of this type of equipment, which are generally accepted and used as good practice throughout the industry, including without limitation, NFPA, Underwriter's Laboratories, OSHA, SAE Publications, American National Standards, Military Standards, etc. The design of all parts and subassemblies shall be in accordance with good commercial practice and shall be the responsibility of the manufacturer to assure safe, efficient and practical design in keeping with requirements peculiar to this type system.
- E. Coordinate with the PLB, GPU, and Potable Water Cabinet equipment for the provisions for, or installation of, all necessary infrastructure prior to final factory painting of the aircraft pre-conditioned air units. The intent is to eliminate site welding/painting after final factory painting. The Owner must approve any exceptions.
- F. Acceptable PCA manufacturers shall be:
  - 1. JBT AeroTech - Jetway Systems
  - 2. ITW GSE (previously Hobart)
  - 3. Cavotec
  - 4. Substitutions – Reference Division 01 - General Requirements.
- G. The Owner, or Owner's tenant, reserves the right to provide branding on the exterior sides of the installed equipment and desires that this branding not be diminished by excessively large or aesthetically displeasing branding of individual pieces of equipment. All manufacturers branding, labeling, marking, etcetera, on their products shall be small compared to the overall size of the device. All branding shall be submitted for approval. The Owner reserves the right to require any non-approved branding be removed from finished products at no additional cost.
- H. The manufacturer shall be a qualified source, who has been regularly engaged in the engineering, manufacturing, and installation of commercial aviation PCA equipment and components for a minimum of five (5) years and with a minimum of one hundred (100) units installed.

- I. Qualified manufacturers and installers will have completed no less than (5) jobs of similar size and scope within the last five (5) years.
- J. The manufacturer shall have proven technical capabilities and adequate manufacturing facilities together with sufficient financial depth and stability to permit prompt and satisfactory execution of the contract.
- K. Manufacturers are required to satisfy all requirements of this specification and the HAS Design Standards Manual which is available on the HAS website. Should the Manufacturer desire to deviate from any portion, either because the specification or manual is in error, violation of any law or regulation, or is in need of modification to permit a more satisfactory functional and economical design, they must submit a written request for such deviation. The Manufacturer shall not contract, purchase, or cause to be delivered, equipment which does not meet all requirements of this document as specified, without obtaining prior written approval.
- L. The Manufacturer shall be responsible for verifying installation locations and methods and shall notify the Owner of any conflicts or code violations prior to manufacture of the PCA units. Verifications shall include field verifications of terminal building heights, appurtenances, and finishes, including terminal doors; electrical, mechanical, special systems, and communications interfaces; as well as PCA mounting provisions and details. Modifications to eliminate conflicts or code violations will be coordinated with and approved by the Owner. Modifications shall be made at no additional cost to the Owner.
- M. The Manufacturer shall furnish and install all necessary equipment to provide a complete, operable, and maintainable unit.
- N. Schedule: See contract drawings for locations/types of PCAs.
- O. Should alternate mounting configurations or physical attributes, other than those specified herein, or indicated on the project drawings, be proposed, manufacturers shall submit alternates.
- P. EMI/RFI: Unit shall be designed so as not to affect aircraft radio/navigation equipment. It shall be applicable throughout the entire aircraft radio frequency range. Provisions shall be designed into the unit to protect it from voltage fluctuations which might result from the operation of aircraft radio frequency equipment.

## 1.6 PROJECT SCOPE

- A. Supply, installation, and twenty-five (25) years turn-key maintenance of new PBBs, GPUs, PCAs, Potable Water Cabinets, and RTUs at HOU and IAH, including all related engineering, design, refurbishment, testing, manufacturing, fabrication, assembly, deliveries, spare parts, training, manuals, special tools, obtaining contract bonds & insurances, shipping charges, installation costs, and any other work related to completion of this contract.
- B. The project will include the removal and scrap of the existing AGSE at HOU and IAH.

## 1.7 PROGRESS SCHEDULE

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. The work under this Contract shall be complete as specified below.
- C. The new PCAs shall be delivered, installed, and commissioned no later than date specified in the Contract documents.
- D. Within fifteen (15) days after the Notice to Proceed is issued to the Contractor, the Contractor shall submit to Owner an acceptable Progress Schedule of Project activities; including at a minimum:
  - 1. Design, Engineering, Preparation and Submittal of all Shop Drawings. Note – Shop Drawings are inclusive of ALL submittal requirements, as set forth in these Specifications.
  - 2. Owner's review and approval of Shop Drawings
  - 3. Material Procurement
  - 4. Manufacture of PCAs
  - 5. Contractor's Factory Tests
  - 6. Factory Tests to be witnessed by Owner, at Owner's discretion
  - 7. Shipping and Delivery
  - 8. Removal and Scrap of Existing PCAs (when applicable)
  - 9. Installation, testing, and commissioning of new AGSE
- E. The Progress Schedule shall be in Gantt Chart format and be developed utilizing MS Projects Software or other Project Scheduling Software approved by the Owner.
- F. The Progress Schedule will be acceptable to Owner if it provides an orderly progression of the submittals, tests, and deliveries to completion within the specified Milestones and the Contract Times. Such acceptance will not impose on Owner responsibility for the progress schedule, for sequencing, scheduling, or progress of the work nor interfere with or relieve Contractor from Contractor's full responsibility, therefore. Such acceptance shall not be deemed to acknowledge the reasonableness and attainability of the schedule.

## 1.8 SHIPPING AND DELIVERY

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.

- B. Contractor shall select the carrier and bear all costs of packaging, transportation, insurance, special handling, and any other costs associated with shipment and delivery.
- C. Contractor shall deliver the new AGSE, F.O.B. Point of Destination, in accordance with the Contract Times set forth in the Contract Documents, or other date agreed to by Owner and Contractor.
- D. Contractor shall provide written notice to Owner at least fifteen (15) days before shipment of the manner of shipment and the anticipated delivery date. Contractor shall also require the carrier to give Owner at least twenty-four (24) hours' notice by telephone prior to the anticipated hour of delivery.
- E. Delivery shall be made to:
  - 1. HOU
  - 2. IAH

#### 1.9 PROJECT MEETINGS AND COORDINATION

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. The Contractor's Project Manager shall schedule, attend, and conduct such Project Meetings as required to:
  - 1. Ensure the Project is executed successfully.
  - 2. Ensure that all parties are fully informed of Project requirements, issues, conflicts, clarifications, interpretations, etc.
  - 3. Resolve any discrepancies or disputes between the Owner and the Contractor.
- C. Travel and per diem costs for any of the Contractor's or their subcontractor's personnel required to travel to HOU or IAH, in any capacity, associated with the Project, and shall be the sole responsibility of the Contractor.
- D. The Contractor's Project Manager shall issue a Monthly Project Status Report to the Owner's designated representative by the fifth (5th) day of each month. This Status report shall include at a minimum, but is not limited to:
  - 1. Current progress against the Contractor's Schedule.
  - 2. Current status of all Contractor Submittals.
  - 3. Any open, unresolved issues or clarifications the Contractor is awaiting a response from the Owner.

#### 1.10 TRAINING

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. The Contractor shall provide separate AGSE Operations and Maintenance classes. These classes will be conducted on-site and shall occur prior to Final Acceptance of the equipment installation.
- C. There shall be a minimum of two AGSE Operations classes which shall include a classroom training course followed by a field training course including allowing each attendee to operate the AGSE and ask questions related to the operations.
- D. There shall be a minimum of one AGSE Maintenance class which shall include a classroom training course followed by a field training course including allowing each attendee to see typical maintenance activities and ask questions related to the maintenance.
- E. Contractor shall submit a Training Syllabus for all training classes to be conducted within thirty (30) days of the Notice to Proceed. Format and content of Contractor's proposed Training classes shall be subject to approval of the Owner.

#### 1.11 SPARE PARTS

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. The Contractor shall provide a recommended spare parts list for spare parts that may be required during first two years of normal operation of the AGSE. This recommended Spare Parts List shall be provided prior to the shipment of the new AGSE.
- C. This recommended spare parts lists shall include the manufacturer's item description, part number, assemblies per unit, the recommended on-hand stocking level, and the current list price.

#### 1.12 WARRANTY

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. Contractor warrants and guarantees to Owner that the title to new AGSE conveyed shall be proper, its transfer rightful, and free from any security interest, lien, or other encumbrance.

- C. Contractor warrants and guarantees to Owner that the new AGSE conforms to the requirements of the Contract Documents, including this Specification and any samples and Shop Drawings approved by Owner.
- D. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
  - 1. abuse, improper modification or improper maintenance or operation by persons other than Contractor, or
  - 2. normal wear and tear under normal usage.
- E. Contractor's obligation to furnish the new AGSE in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of new AGSE that are non-conforming, or a release of Contractor's obligation to furnish the new AGSE in accordance with the Contract Documents:
  - 1. observations by Owner;
  - 2. recommendation by Owner or payment by Owner of any progress or final payment;
  - 3. use of the new AGSE by Owner;
  - 4. any acceptance by Owner or any failure to do so;
  - 5. the issuance of a Final Acceptance notice by Owner; or
  - 6. any inspection, test or approval by Owner or Owner's representatives.
- F. Owner shall within a reasonable time notify Contractor of any breach of Contractor's warranties or guarantees. If Owner receives notice of a suit or claim as a result of such breach, Owner also may give Contractor notice in writing to defend such suit or claim. If Contractor fails to defend such suit or claim, Contractor will be bound in any subsequent suit or claim against Contractor by Owner by any factual determination in the prior suit.
- G. The Contractor warrants to the Owner that all materials (namely the new AGSE) furnished under this Contract shall be of good quality, free from faults and defects and in conformance with Contract requirements. Any work not so conforming to these standards may be considered defective. If, within one (1) year after the date of Owner's final acceptance of the work, the new AGSE are found to be defective or not in accordance with Contract requirements, the Contractor shall correct it at no cost to the Owner within five (5) days after receipt of written notice from the Owner to do so.
- H. For any new PCAs supplied for this Project, the Contractor shall provide:
  - 1. An extended 2-year Warranty from final acceptance agreeing to replace, repair, or restore any defective materials and workmanship of the AGSE.
  - 2. These extended warranties shall be in addition to, and not a limitation of, other rights the Owner may have against the Contractor under the Contract Documents.



- I. The Contactor shall supply Warranty Certificates, in favor of the Owner for all AGSE supplied under this Contract. Such Warranty Certificates shall be supplied with the Final Payment Application.
- J. The Contractor shall supply the Manufacturer's Warranty Certificates, in favor of the Owner, for all new AGSE supplied under this Contract. Such Warranty Certificates shall be supplied with the Final Payment Application.
- K. The Warranty obligations of the Contractor defined herein shall not be limited by any obligations otherwise prescribed by law.
- L. Upon Final Acceptance of the new AGSE, the Contractor shall furnish a good and sufficient Warranty / Maintenance Bond, in the sum of not less than 100% of the Contract amount, guaranteeing that that Contractor will faithfully fulfill the Warranty obligations of the Contract. Such bond shall remain in effect at least one year after the date of final acceptance, except as required by additional warranty and guarantee periods stipulated by Laws or Regulations.
- M. The Warranty / Maintenance Bond shall be executed by a Surety:
  - 1. Satisfactory to the Owner
  - 2. Licensed to conduct business in the State of Texas
  - 3. Named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 by the Financial Management Service, Surety Bond Branch, and U.S. Department of the Treasury.
- N. Bonds signed by an agent must be accompanied by a certified copy of such agent's authority to act.
- O. The bonds, along with appropriate Power of Attorney, shall be delivered to Owner, but in no event shall these documents be delivered to the Owner later than fifteen (15) days from the date of Final Acceptance of the AGSE. If, at any time after the execution of the Warranty / Maintenance Bond as above required, Owner shall deem the surety or sureties upon such bond to be unsatisfactory, or if, for any reasons, such bond ceases to be adequate to cover the performance of the Warranty, Contractor shall, at its expense within five (5) days written notice from the Owner to do so, furnish additional bond or bonds in such form and amount and with such surety or sureties as shall be satisfactory to the Owner.
- P. If the Surety on a bond is declared bankrupt or becomes insolvent or its right to do business in the State of Texas or it ceases to meet the requirements of the Warranty clauses stated above, the Contractor shall provide another bond and Surety which comply with those requirements within 5 days, at Contractor's expense.

### 1.13 MANUALS

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. One searchable electronic and three (3) copies of the new AGSE OEM's O&M manuals shall be provided prior to the AGSE O&M training.

### 1.14 MATERIALS

- A. Unless otherwise indicated, it is understood and agreed that ANY materials used or otherwise incorporated into the installation of the AGSE or in the manufacture of the AGSE by the Contractor shall be NEW and UNUSED. If required by the Owner, the Contractor will furnish satisfactory evidence as to the kind and quality of materials and equipment.
- B. Whenever an item of material or equipment to be incorporated into the new AGSE is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Contractor or manufacturer, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, other items of material or equipment or material or equipment of other suppliers or manufacturers may be submitted to Owner for review and approval.
  - 1. If in Owner's sole discretion, such an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related work will be required, it may be considered by Owner as an "or equal" item.
  - 2. For the purposes of this clause, a proposed item of material or equipment may be considered functionally equal to an item so named if:
    - a. in the exercise of reasonable judgment, Owner determines that:
      - 1) it is at least equal in quality, durability, appearance, strength, and design characteristics; and
      - 2) it will reliably perform at least equally well the function imposed by the design concept of the completed Project as a functioning whole; and
    - b. Contractor certifies that:
      - 1) there is no increase in any cost including capital, installation or operating to Owner; and
      - 2) the proposed item will conform substantially, even with deviations, to the detailed requirements of the item named in the Contract Documents.
- C. The Owner will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Paragraph 2 above. Owner will be the sole judge of acceptability. No "or equal" will be ordered, manufactured, or utilized until Owner's review is complete, which will be evidenced by an approved Shop Drawing. Owner

will advise Contractor in writing of any negative determination. Notwithstanding Owner's approval of an "or equal" item, Contractor shall remain obligated to comply with the requirements of the Contract Documents.

- D. The Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any such proposed "or-equal."
- E. Contractor shall provide all data in support of any such proposed "or equal" at Contractor's expense.

#### 1.15 APPLICABLE CODES AND STANDARDS

- A. The PCA and all of the accessories and mounting brackets and hardware shall be designed and manufactured to meet U.S. Codes and Regulations that have been adopted by the Aircraft Pre-Conditioned Air Unit industry. Portions or all of certain recognized industry or association standards referred to herein as being a requirement of these Specifications shall be considered as binding as though the reproduced in full herein unless supplemented and/or modified by more stringent requirements in this Specification. Unless otherwise stated, the reference standard shall be the standard which is current as of the date of issuance of these Specifications.
- B. Applicable Industry and Association Standards:
  - 1. FM P7825 - Approval Guide; Factory Mutual Research Corporation
  - 2. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association
  - 3. NFPA 70 - National Electrical Code; National Fire Protection Association
  - 4. NFPA - "Standard on Construction and Protection of Aircraft Loading Walkways No. 415"
  - 5. SSPC-Paint 15 - Steel Joist Shop Paint; Society for Protective Coatings (Part of Steel Structures Painting Manual, Vol. Two)
  - 6. AFBMA - Anti-Friction Bearing Manufacturers Association
  - 7. ARI - Air-Conditioning and Refrigeration Institute
  - 8. ARI Standard 410 - Standard for Forced-Circulation Air-Cooling and Air Heating Coils
  - 9. ARI Standard 850 - Commercial and Industrial Filter Equipment
  - 10. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers
  - 11. ASHRAE 52 - Method of Testing Air-Cleaning Device Used in General Ventilation for Removing Particulate Matter

12. NEBB - National Environmental Balancing Bureau Agency
  13. ATA 101 - Air Transport Association of America - Specification for Ground Equipment Technical Data
  14. SAE - Society of Automotive Engineers.
  15. AISC - American Institute of Steel Construction Code
  16. ASME - American Society of Mechanical Engineers
  17. OSHA - Occupational Safety and Health Act
  18. UL - Underwriters Laboratories.
  19. MS-33562 - Military Specification, Connection, Aircraft Ground Air Conditioning, 8".
  20. ANSI/UL 1449 Standard for Surge Protective Devices
  21. IEEE Std 1100 Recommended Practice for Powering and Grounding Electronic Equipment
  22. Houston Airport System (HAS) Design Standards Manual
- C. In the event of conflict between a reference and another reference or this specification, request clarifications. All responses are final and will be at no additional cost to the Owner.

#### 1.16 SUBMITTALS

- A. Bid-Submittals: The following submittals shall be included with bid.
1. Alternates.
  2. Spare Parts List: Provide manufacturer's recommended spare parts list.
  3. UL Certifications.
- B. Pre-Manufacture Submittals: The following submittals shall be made as necessary to meet the project schedule and shall be submitted and approved prior to manufacturing the PCA units.
1. Product data for selected models including specialties, accessories, and the following:
    - a. Direct expansion (Dx) Point-Of-Use (POU) Preconditioned Air (PCA) unit airflow performance curves with system operating conditions indicated; include: airflow vs static pressure and airflow vs blower horsepower.
    - b. Manufacturer shall submit performance data of the PCA units at the design conditions indicated in this Section. Performance data shall include, but not be limited to, air flow, static pressures, temperatures, and humidity levels, at points of significance through the unit and at the aircraft inlet, refrigerant

- pressures, and temperatures at points of significance through the refrigeration circuits, and power requirements of major components as well as entire unit.
- c. Motor ratings and electrical characteristics including motor and fan accessories.
  - d. Materials, gauges, and finishes.
  - e. Dampers, including housings, linkages, and operators.
  - f. Air filter manufacturer's technical product data including dimensions, weights, required clearances and access, flow capacity including initial and final pressure drop at rated air flow, efficiency and test method, fire classification, and installation instructions.
  - g. Certification report of airflow test apparatus by an independent third party such as the National Environmental Balancing Bureau (NEBB) or other approved agency.
  - h. Dx POU unit air flow control, capacity control and defrost control.
  - i. Flexible hoses, clamps, rigid ducts, and mounting brackets.
2. Shop Drawings: Provide schematics and interconnection diagrams, indicate front and side views of enclosures with overall dimensions and weights shown; conduit/cable entrance locations and requirements; and nameplate legends. Differentiate between manufacturer-installed wiring and field-installed connections. Include appurtenances such as hose baskets, ducts, pushbuttons, etcetera.
  3. Installation Details: Provide complete installation details including, without limitation, installation details of all appurtenances. Show installed configuration as well as any pertinent details regarding interface to other equipment and systems, include electrical connection service points.
  4. Resume or CV of manufacturers project manager.
- C. Pre-Ship Submittals: The following shall be submitted and approved prior to shipping PCA units to the project site:
1. Factory Acceptance Testing Reports: Indicate factory acceptance tests and results and inspection procedures.
  2. Installation Subcontractor and resume or CV of Installation Site Manager.
  3. Written Notice to Owner of scheduled delivery date and time at least 15 days prior to shipment.
- D. Pre-Substantial Completion Submittals: The following submittals shall be submitted and approved prior to 14 days before substantial completion, unless otherwise noted herein.
1. Operation and Maintenance Manuals.
  2. Training Program: At least 60 days prior to substantial completion, a training program summary, course syllabus, instructor qualifications, and copy of the training manual shall be submitted for review and approval.

3. On-Site Functional Testing Report: Submit proposed on-site functional testing report for approval.
- E. Pre-Final Acceptance Submittals: The following submittals shall be submitted and approved prior to 14 days before final acceptance.
1. As-Built Drawings. Provide field edited redlined project drawings showing deviations from design documents.
  2. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and have been registered with the manufacturer.
  3. On-Site Functional Testing Report: A completed field on-site functional testing report for each installed unit as specified herein. Utilize approved form.
  4. Training Rosters. Provide training roster with trainee names, dates, and types of training, as well as durations.
  5. Original software and documentation registered in the Owner's name.
  6. Hard copy and electronic version (compact disk or flash card) copies of all programs and settings loaded into equipment provided hereunder.

#### 1.17 QUALITY CONTROL

- A. ARI Compliance: Air filter equipment shall comply with ARI 850.
- B. ASHRAE Compliance: Air filters shall comply with ASHRAE Standard 52 for method of testing and for recording and calculating air flow rates.
- C. NFPA Compliance: Comply with applicable portions of NFPA 70 and NFPA 415 for components and installed PCA Units.
- D. NEMA Compliance: Motors, enclosures and electrical accessories shall comply with NEMA standards and be so rated.
- E. UL Compliance: PCA units shall be UL, or ETL listed and shall be labeled by a nationally recognized testing laboratories at the time of bid. Submit verification with bid submittals.

#### 1.18 GENERAL DESIGN REQUIREMENTS

- A. The manufacturer shall provide a new, compact, light-weight, low-noise and insulated PCA unit that can be mounted under the PLB, such that the operational characteristics of the bridge are unrestricted and the bridge's structural integrity is uncompromised. It is the Engineer's intent to have the PCA units mounted under the "C" tunnel, at the aircraft end of the PLB.
  1. The PCA unit manufacturer shall ensure the unit and the unit's mounting methods are structurally sound and that they do not affect the structural integrity of the PLB.

The Dx unit shall not cause deflections of the PLB tunnel sections or rails. The PCA unit shall not affect the dynamic operation of the PLB. All steel, rails, brackets, bolts, reinforcing, etcetera shall be provided and installed with the proper ratings for the finished system.

- B. In the event the manufacturer's equipment, or project conditions, will not allow for under "C" tunnel mounting, alternative mounting arrangements will be considered. Alternates, which include roof mounting, shall include all items necessary for a complete and safe system, including ductworks, brackets, access ladders and handrails to allow full maintenance of units in a safe and OSHA compliant manner.
  - 1. All mounting brackets, hose brackets, handrails, and other exposed metal surfaces shall be primed and painted to match the color of the new passenger boarding bridge.
  - 2. All unit exterior exposed ductwork shall be double wall insulated duct as indicated on the project drawings.
- C. Maximum Dimensions and Weights: (LxWxH, weight)
  - 1. Class I: (90", 88", 43", 3000 lbs)
  - 2. Class II: (170", 88", 45", 4500 lbs)
  - 3. Class III: (170", 88", 45", 6500 lbs)
  - 4. Class IV: (205", 88", 59", 7500 lbs)
  - 5. Class V: (205", 88", 59", 8300 lbs)
- D. The PCA units shall have a minimum of two (2) distinct assemblies:
  - 1. A control assembly which contains the low voltage logic and control circuits.
  - 2. A blower/coil unit containing a blower, inlet butterfly damper, cooling coils, compressors, condenser coil, condenser fans, filters, complete motor starting equipment, outlet plenum and condensate drain pan to provide the required cooled or heated air to maintain the aircraft cabin temperature specified.
- E. Each PCA unit shall be primed and painted to match the color of the PLB on which it is installed.
- F. Each PCA unit shall operate properly to serve the full range of aircraft which park at its respective gate position. It shall be the manufacturer's responsibility to review the aircraft parking plans and verify that the units supplied will meet this requirement. Unit sizing indicated in the contract documents shall be considered the minimum sizing of units supplied.
- G. Unit external static pressure shall be defined as the gauge pressure measured at the outlet of the PCA unit. The PCA units manufacturer shall submit the gauge pressure the PCA unit can produce at the outlet of the hose and at the aircraft connection through 75' of 14" hose.

- H. The maximum sound level for the PCA units at maximum cooling/heating shall not exceed 85 dBA at a distance of 15' from the unit (external) and 65 dBA inside the bridge (internal).
- I. The PCA unit components shall operate satisfactorily under ambient temperature conditions of -20° to 140° F (-29° to 60° C) including static soak up to 48 hours within this range with or without wind of 50 MPH. All components shall be designed or selected for long service life under such conditions
- J. The PCA units shall not produce or induce objectionable vibrations into the bridge structure. Vibration levels induced by the units and/or its components shall not be injurious to the units or the bridge structure or be harmful or annoying to passengers and employees. The manufacturer shall provide any and all necessary vibration insulation devices required to meet this requirement. The blower wheel and shaft assembly shall be direct coupled to the motor and shall receive a two (2) plane dynamic balance at maximum RPM and the maximum allowable vibration velocity shall not exceed 0.1 inch/second or 0.5 MIL displacement.
- K. The PCA units shall be designed so as not to affect aircraft radio/navigation equipment. It shall be applicable throughout the entire aircraft radio frequency range. Provisions shall be designed into the PCA unit to protect it from voltage fluctuations which might result from the operation of aircraft radio frequency equipment.
- L. Where the PCA unit components are assembled within a unitized enclosure, provide access doors of the hinged and insulated type. Locate as required for proper access to the following:
  - 1. Blower/dampers.
  - 2. Filters.
  - 3. Coils.
  - 4. Compressors.
  - 5. Motors.
  - 6. Variable Frequency Drives (VFD).
  - 7. Smoke Detectors.
  - 8. Any other item requiring maintenance access at the discretion of the Engineer.
- M. The PCA units shall be supplied with any and all necessary ducts, transition hoses and brackets required to route the discharge air from the Dx units to a point above and then to the hose storage device. Such installation method shall ensure that air flow equipment is not restricted or interfered with during any and all PLB operations.
- N. The minimum reliability design requirement for the PCA units shall be to operate between preventative maintenance periods of a minimum of 840 operating hours or 12 weeks, whichever comes first.



- O. The PCA unit design shall be based on the use of self-contained refrigeration systems and an electrical heater combined successively by the supply air passage and operationally by a common control system.
  - 1. Primary and secondary systems shall form the basic unit.
  - 2. Primary and/or secondary systems within the basic two-system arrangement may be divided into multiple refrigeration sub-systems for severe capacity requirements caused by extreme design ambient conditions and/or air flow parameters.

## 1.19 PERFORMANCE REQUIREMENTS

### A. Cooling:

- 1. The PCA units shall be designed to automatically maintain a 75°F cabin temperature in all aircraft within its specified class, based on the following design conditions.
  - a. Design ambient temperatures: 98°F/80°F Dry Bulb/Wet Bulb.
  - b. Passenger Load: Full (100%), for the largest aircraft in its classification, including full crew.
  - c. Full solar load (bright sunshine).
  - d. Aircraft electrical load: 115,000 BTU/h.
  - e. One aircraft door open (typically either L1 or L2).
- 2. Additional Minimum Design Requirements/Parameters:
  - a. Class I PCA units: Shall be capable of providing a minimum of 120 lb/min of 35°F air at 10" of static pressure at the end of a single 14" diameter 75' long insulated air hose connected to an 8" diameter aircraft connector. Minimum nominal machine rating shall be 20 Tons.
  - b. Class II PCA units: Shall be capable of providing a minimum of 180 lb/min of 35°F air at 22" of static pressure at the end of a single 14" diameter 75' long insulated air hose connected to an 8" diameter aircraft connector. Minimum nominal machine rating shall be 30 Tons.
  - c. Class III PCA units: Shall be capable of providing a minimum of 300 lb/min of 35°F air at 22" of static pressure at the end of a single 14" diameter 75' long insulated air hose connected to an 8" diameter aircraft connector. Minimum nominal machine rating shall be 60 Tons.
  - d. Class IV PCA units: Shall be capable of providing a minimum of 400 lb/min of 35°F air at 22" of static pressure at the end of dual 14" diameter 75' long insulated air hoses connected to 8" diameter aircraft connectors. Minimum nominal machine rating shall be 90 Tons.
  - e. Class V PCA units: Shall be capable of providing a minimum of 550 lb/min of 35°F air at 22" of static pressure at the end of dual 14" diameter 75' long insulated air hoses connected to 8" diameter aircraft connectors. Minimum nominal machine rating shall be 120 Tons.
  - f. The PCA units shall be capable of operating at an increased air flow rate (up to 15% above the nominal value) with coincident decrease in static pressure. Operation at these conditions on design day will be allowed to raise the supply air temperature by up to 5°F.

3. All temperatures, air flow rates, and static pressures denoted in this section must be simultaneously achieved.

B. Heating:

1. The PCA units shall be designed to automatically maintain a 75°F cabin temperature in all aircraft within its specified class, based on the following design conditions.
  - a. Design ambient temperatures: 0°F Dry Bulb.
  - b. Passenger Load: None (0%), for the largest aircraft in its classification.
  - c. No solar load.
  - d. Aircraft electrical load: 0 BTU/h.
  - e. One aircraft door open (typically either L1 or L2).
2. Additional Minimum Design Requirements/Parameters:
  - a. Class I PCA units: Shall be capable of providing a minimum of 60 lb/min of 140°F air at the end of a single 14" diameter 75' long insulated air hose connected to an 8" diameter aircraft connector.
  - b. Class II PCA units: Shall be capable of providing a minimum of 90 lb/min of 140°F air at the end of a single 14" diameter 75' long insulated air hose connected to an 8" diameter aircraft connector.
  - c. Class III PCA units: Shall be capable of providing a minimum of 150 lb/min of 140°F air at the end of a single 14" diameter 75' long insulated air hose connected to an 8" diameter aircraft connector.
  - d. Class IV PCA units: Shall be capable of providing a minimum of 200 lb/min of 140°F air at the end of dual 14" diameter 75' long insulated air hoses connected to 8" diameter aircraft connectors.
  - e. Class V PCA units: Shall be capable of providing a minimum of 225 lb/min of 140°F air at the end of dual 14" diameter 75' long insulated air hoses connected to 8" diameter aircraft connectors.
3. All temperatures, air flow rates, and static pressures denoted in this section must be simultaneously achieved.

## 1.20 ELECTRICAL REQUIREMENTS

- A. All PCA units shall be constructed in accordance with standard electrical manufacturing processes, and shall comply with all applicable Federal, State, and Local laws, codes, and ordinances.
- B. Input Voltage Rating: 480V, 3 phase, 60 hertz.
- C. The PCA units shall be provided with a built-in, main circuit breaker of suitable size that provides an electrical disconnecting means for the PCA unit and protection from short circuits. This circuit breaker shall be lockable in the OFF position for maintenance purposes.
  1. All primary disconnecting means shall be suitably rated to be capable of withstanding and interrupting fault currents available at the input.

D. Wiring, Motors, and Electrical Components

1. All wiring shall be permanently identified. Wrap around adhesive style wire markers will not be permitted. Numbers are to be located one inch from the end of each termination point. If the wires are to be stamped, they must be numbered the full length with indelible ink, with the numbers no more than four inches apart, and the number shall be visible at all terminating points. Wires are to be numbered in a logical sequence. Manufacturer shall indicate all wire numbers on electrical drawings.
2. All circuits shall have suitable overload protection. Each conductor shall be sized to have current carrying capacity as allowed by the National Electrical Code (NEC) equal to or greater than the capacity of the circuit breaker provided in its circuit. Circuit breakers shall be grouped in convenient locations and suitably marked for size and function. Logical grouping of circuits is anticipated. Protection devices shall be sized to protect wiring and motors from damage due to overload and prevent electrical or mechanical damage to associated PCA unit components in the event of failure of one of the components. Each electric motor shall have a suitable magnetic starter providing over-current and under-voltage protection, and each motor circuit shall be separately protected by fuses or circuit breakers. Optional and add on components shall be considered in sizing and in the number of conductors provided. Spare wires shall be provided as necessary.
3. All wiring shall be terminated on terminal blocks and/or suitable connectors. The wiring shall be formed and restrained to give a neat appearance. Common wiring splices shall not be used. Connections shall be made using terminal strips and staked lugs or by patent connectors.
4. Grommets and suitable anti-chafe material shall be used where wires are required to pass through structure or other similar relief or opening which exposes the wire to possible chafing. All wiring shall be in conduit (preferably automotive split loom) or spot-tied and shall be routed away from possible pinch points. Wiring shall be adequately supported to protect it from damage due to ice and snow buildup, bumping, kinking, and flexing.
5. All meter panels and any components containing printed circuit boards or solid state electronics shall be shock mounted or designed installed as necessary to negate the need for shock mounting.
6. Electrical interlocks shall be fail-safe design.
7. Electrical devices including switches, relays, wiring, and terminals when located in an area exposed to weather, shall be of weatherproof design or protected by weatherproof enclosures.
8. Weatherproof schematics shall be installed on the interior of the controller door. Schematics shall include all wiring and devices and shall include all wire numbers. Schematic shall be impervious to grease, water, ice, or other elements that they may be exposed to in an aviation maintenance environment on an active apron with the doors open.

9. All exterior conductors/cables shall be in conduit. Exposed cables will only be allowed where required due to flexibility needs and then will be limited to a maximum of 48".

E. Ampacity.

1. Each POU PCA Dx unit shall operate satisfactorily, at full load, with the following electrical circuits provided. Each unit's minimum circuit ampacity, calculated in accordance with the NEC, shall not exceed the ampacity of the circuits provided. Circuits to be provided are:
  - a. Class I: FLA 50A, MCA 65A, MOP 70A.
  - b. Class II: FLA 90A, MCA 105A, MOP 125A.
  - c. Class III: FLA 130A, MCA 160A, MOP 175A.
  - d. Class IV: FLA 215A, MCA 260A, MOP 300A.
  - e. Class V: FLA 350A.

## 1.21 COMPONENTS AND OPERATION

A. Compressor(s):

1. Compressor(s) shall be serviceable, single-speed, hermetic sealed scroll compressors with integral vibration isolators and crankcase heaters which de-energize during compressor operation. Safety controls shall include a low/high refrigerant pressure cutout with manual reset, a compressor motor overload with manual reset, an adjustable low-ambient lockout, and low oil pressure cutout with manual reset.
2. High efficiency shall be achieved through the use of complete enclosed compression chamber design.
3. Vibration isolator/absorber with a wire mesh-covered metallic bellows shall be installed in the suction and discharge line to isolate/absorb the compressor vibrations.
4. A 2-pole compressor motor shall be designed as an integral part of the compressor assembly. It shall drive the compressor scroll or screw. Industrial Grade epoxy shall lock the motor windings in place and resist corrosion of insulation by refrigerant and oil.

B. Casing:

1. Manufacturer's standard casing construction, having corrosion protection coating, and exterior finish. Where the PCA unit is provided as a unitized enclosure construction, casings shall have removable panels or access doors for inspection and access to internal parts, a minimum of 1" thick thermal insulation, knockouts for electrical and exterior condensate drain connection, and lifting lugs.

C. Blower:

1. Provide blower that is factory fabricated and assembled, factory tested and factory finished, with required capacities and characteristics. The blower shall be

centrifugal type and sized for the appropriate constant volume airflow requirements in accordance with the selected size of the PCA unit. The blower motor shall be selected such that the fan brake horsepower does not exceed the maximum supplied by the motor over the design operating range of the PCA unit.

2. Blower and Shafts: Statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower. Vibration shall not be more than 0.1 inches/second or 0.5 MIL displacement. Blower shaft to be turned, ground, and polished steel designed to operate at no more than 70% of the first critical speed at the top of the speed range of the fan's class.
  3. Shaft Bearings: Provide bearings having a median life "Rating Life" (AFBMA L50) of 200,000 calculated in accordance with AFBMA 9 for ball bearings or AFBMA 11 for roller bearings.
  4. Blower: Centrifugal, direct-drive fans; and permanently lubricated motor bearings where bearings are not accessible for greasing.
  5. A 2-pole, drip-proof blower motor shall be directly connected to the blower impeller. Motor shall be of NEMA Design B, Class F insulation, 1.15 S.F.
- D. Condenser Fan:
1. An axial type multi-blade fan shall be utilized for condenser air flow. Fan blades shall be constructed from spark and corrosion proof material. Each PCA unit shall utilize two (2) identical motor/fan assemblies.
  2. A 4-pole, totally enclosed fan-cooled fan motor shall be directly connected to the fan propeller. Motor shall be NEMA Design B, Class F insulation, 1.15 S.F.
- E. Factory Finish:
1. Exterior Sheet Metal Parts: Prime coating prior to final assembly. Final color to match the PLB.
  2. Interior Surfaces: All air flow surfaces shall be stainless steel or aluminum. Manufacturer's standard finish is acceptable on all other interior surfaces.
- F. Coils:
1. Aluminum plate fins and seamless copper tube. Fins shall have collars drawn, belled, and firmly bonded to the tubes by means of mechanical or hydraulic-expansion of the tubes. No soldering or tinning shall be used in the bonding process. Coils shall have a galvanized steel casing and shall be easily removable for maintenance.
  2. Coils shall be constructed and tested in general accordance with ASHRAE 15 and ARI 410.
  3. Coils shall be proof tested to 450 psig and leak tested to 250 psig with air pressure under water, cleaned, dehydrated, and sealed with a holding charge of nitrogen until serviced with refrigerant.

4. Each compressor coil section shall have an expansion valve, a solenoid valve, and a distributor.
  
- G. Airflow Control: Airflow control shall be via a VFD driven blower motor to control the air flow capacity of the blower. The VFD shall automatically adjust the air flow during aircraft cooling to the requirements of the aircraft selected on the remote control station. During aircraft heating, the VFD shall automatically adjust to the 50% mass air flow position for the aircraft selected on the remote control station.
  
- H. Air Flow Ducting:
  1. All ducting, plenum transitions, and other air flow components shall be made from either aluminum or stainless steel.
  2. Plenum and air flow ductwork shall be properly insulated with polyurethane foam insulation so as to prevent the forming of condensation on ductwork surfaces and as necessary to minimize impacts to unit performance.
  
- I. Inlet Air Filters:
  1. Inlet air filters shall be factory fabricated by a company regularly engaged and specialized in filter manufacturing. Filters shall be cleanable, encased in a metal frame, and rated for the application for which they are being used. The air filters shall meet the following minimum requirements.
    - a. The PCA units shall utilize standard size, commercially available, cleanable air filters. Filter media shall be made from polyurethane foam an open cell structure providing high arrestance and dust-holding capacity. Foam material shall have a flame-resistant additive making it self-extinguishing.
    - b. The metal enclosing frame shall be constructed of rigid, heavy duty, and at least 20 gauge galvanized steel.
    - c. Face velocity shall be no greater than 500 feet per minute with an initial resistance of 0.3" water gauge, final resistance of 0.5" water gauge, and an average resistance of 80%.
    - d. The filter section shall be furnished with a differential pressure sensor measuring across all filters to activate a "dirty filter" alarm. The PCA unit shall be equipped with a visual indicator for notification of alarm.
  
- J. Refrigerant:
  1. Acceptable refrigerants:
    - a. R-134A.
    - b. R-407C
    - c. R-410A
  
- K. Refrigerant Filter-Dryer: A sealed type filter-dryer shall be installed in the liquid line to remove moisture and contamination from the refrigerant. The filter-dryer shall be soldered in place to preclude leakage. Location and installation method shall not inhibit or preclude field replacement of the filter-dryer unit. Filter-dryer shall contain a 100-mesh screen and molded blend of desiccant for acid and water removal.

- L. Refrigerant Sight Glass: A combination moisture and liquid indicator shall be designed and installed in the liquid line to monitor the flow and moisture content of the refrigerant. The indicator shall have a large crystal clear glass for viewing refrigerant and shall be protected by a pad and screen and shall change color on the basis of moisture content of the refrigerant.
- M. Expansion Valve: A thermostatic expansion valve shall automatically meter the refrigerant flow to the evaporator coil by sensing the evaporating pressure and temperature of the vapor leaving the evaporator. The valve shall regulate the rate of liquid refrigerant flow into the evaporator coil in exact proportion to the rate of evaporation of the liquid refrigerant by maintaining the pre-adjusted superheat. This shall optimize the evaporator efficiency and prevent the return of the liquid refrigerant to the compressor. The valve shall also contain an external equalizer to compensate for the pressure drop in the evaporator coil.
- N. Electric Heat:
  - 1. Staged Electric heat shall be provided on each PCA unit. Each PCA unit shall consist of a minimum of two (2) stages of electric heat. Each unit shall have a total heat capacity as necessary to meet the performance requirements outlined in the Heating Section of this specification. The electric heater shall be designed such that the power consumption in the Heating mode shall not exceed the maximum power consumption in the Cooling mode. The intent of this paragraph is to maximize the available stages of heat for optimal performance.
  - 2. Heat strips shall be interlocked to prevent energizing in the absence of adequate air flow across the heat strips.
  - 3. The heat strips shall be locked out of operation if ambient is greater than 65° F. The heat strips shall be deactivated if the plenum temperature exceeds 150° F. Upon plenum temperature dropping below 150° F, the heat strips shall automatically re-activate.
- O. Controls:
  - 1. The PCA Dx Unit shall be provided with Control Logix, Compact Logix programmable logic controller manufactured by Allen Bradley, per the HAS Design Standards Manual.
  - 2. Controllers shall monitor all phases of operation of the PCA Unit. The controller shall be based on a 32 bit microprocessor and utilize flash memory technology to store operation parameter information. Operation parameters of controller shall not be affected by loss of 60 Hz power to controller. PCA manufacturer shall provide with their bid a detailed description of the controller, type of graphics and software, sequence of operation, types and number of control points, and limitations of the control system they intend to provide and install.
    - a. The practice of sharing the passenger boarding bridge controller, either directly, or through remote I/O racks will not be permitted. Each PCA unit shall have a dedicated and separate controller.
  - 3. Portable Laptop Computer:

- a. The PCA manufacturer shall configure the portable laptop computer for Local access to each PCA Dx unit controller.
  - b. Portable laptop computer shall include all hardware and software required to support local communications, troubleshooting and programming to/of the PCA Dx Unit's controller. This access shall be password protected and shall be fully capable of controlling or modifying PCA Dx unit's current database or control program. All Software shall be licensed and registered in the Owner's name.
4. Control system shall be low voltage (12 & 24 VAC). Control transformer shall be provided and sized to adequately serve all connected loads.
  5. Contactors shall be full voltage non-reversing type and designed to meet international standards including UL and IEC. Contactors shall be AC operated with 120V 50/60 Hz holding coil and functionally assigned for ON-OFF control. Thermostats shall be utilized in the system to maintain the required temperature parameters of the supply air.
- P. Interlocks: Unit shall interlock with the PLB to prevent PLB horizontal operation while PCA unit is operating. Coordinate with the Apron Drive Passenger Loading Bridge Specification Section. This shall apply to all units as well as all PLBs. Appropriate messages shall be displayed at the PLB operator's console to indicate unit's run status is preventing PLB operations.
- Q. Remote Control Station:
1. The control station shall be housed in a NEMA 4X stainless steel enclosure, and shall operate on 24 volts or less and shall be located on the bridge lift column (aircraft side of the bridge), so as to be accessible from ground level. Coordinate this position with all other installed equipment and ancillaries so as to prevent interferences. The station shall be configured as indicated on the design drawings. Modifications to this configuration must be submitted and approved.
  2. The control station shall have a fault-indicator lamp as follows.
    - a. Flash: non-critical fault, PCA unit still operational.
    - b. Steady: critical fault, PCA unit prevented from operating.
  3. The control station shall have a selector switch to choose the aircraft the PCA Unit is to serve. This selector switch shall be as shown on the drawings and shall be labeled with the abbreviations of the class of aircraft as follows (varies by model):
    - a. RJ (Regional Jets)
    - b. NB (Narrow Body Aircraft)
    - c. 757/767
    - d. WB (Wide Body Aircraft)
    - e. JBO (Jumbo Aircraft)
- R. Cabin Temperature Indicator:
1. Cabin Temperature control shall have a user variable controller installed in lieu of the traditional sensor. The controller should have a metallic knob. The controller face should contain a rotated set of tick marks with the labels of "Cooler" and



"Warmer" on the extreme ends. The tick marks and labels should be engraved or etched in the controller faceplate. The design should be completed in a manner that simulates the electrical value of the targeted Cabin temperature setpoint when the knob is in the center of the scale.

- S. Condensate Drains: Condensate shall automatically drain to the ramp surface.
- T. PCA Air Hose:
1. Each PCA unit shall be provided with single or dual, as specified, length as indicated on drawings, of 14" diameter insulated hose and one 14" to 8" reducer terminating with an aircraft coupling. Complete hose assembly and connectors shall conform to MS- 33562. This requirement shall apply to each output of dual hose units.
    - a. Hose lengths specified, or indicated on drawings, are a minimum length only. Provide and install sufficient hose lengths to reach all aircraft capable of being serviced at the gates as indicated on the aircraft parking plans.
  2. Air delivery hose shall be of the lightweight insulated type, maximum thermal conductance of 1.28 BTU/hr/ft/°F, pressure rated for 50" water maximum. Hose shall be 14" diameter flat type. Hose is to be supplied in sections of no more than 25' in length, connected with Velcro seals (zippers not allowed), with a 14" to 8" diameter reducing adaptor on the end section. Approved Manufactures are:
    - a. J&B Aviation (SuperHose)
    - b. Estex
    - c. Substitutions – Reference Division 01 - General Requirements
  3. All ducts, hose support sleeves, and mounting hardware shall be provided and installed in accordance with the contract drawings and shall be painted to match the color of the newly installed passenger boarding bridge.
- U. Hose Basket:
1. The hose storage basket shall be manufactured and installed in accordance with the Project Drawings, suitably modified only to accommodate differences in bridge configuration. The basket shall be fabricated from a minimum of 1-1/2" steel tubing. The basket shall be equipped with four (4) swivel casters permitting movement with the bridge and shall be designed with an "open" bottom allowing rain, snow, trash, etc. to pass through.
  2. The hose storage basket shall be installed at an approved location at the front or side of the wheel bogey (as necessary based on aircraft serviced) of each bridge and shall be of sufficient size to easily store the required quantity and length of hose. Basket shall be swivel mounted so as to allow the basket to accommodate sloping ramp surfaces while maintaining all swivel casters in contact with the ramp surface. Hose storage basket and PCA unit shall be installed such that they do not interfere with the PLB operation for the full range of aircraft served. PCA hoses must be fully accessible when PLB is lowered to its lowest position as determined by the mix of aircraft served. Excess hose shall deposit into hose basket as PLB is lowered from a raised position. Hose storage basket shall be constructed of metal, primed, and painted safety yellow.

- V. Mounting Brackets: Factory fabricated mounting brackets shall be utilized for installation of the PCA Dx unit. Design of these brackets shall be such so as to prevent any welding or cutting of the bridge components to facilitate installation. Brackets shall be universal in nature so as to allow for installation on industry standard, commercially available passenger boarding bridges.
- W. Safety Provisions:
1. All corners of the unit's lower rim shall be equipped with corner bumpers.
  2. The entire lower rim, and all vertical corner edges of the PCA unit shall be distinguished with an alternating yellow/black adhesive safety tape. Safety tape minimum width shall be 2 inches.
  3. The lower corners of all units shall be equipped with fluorescent safety corner locator rods as necessary to match airfield standards.
  4. The electric circuitry of the PCA units shall be protected against short-circuit currents or grounds by means of circuit breakers.
  5. Each motor shall have separate overload protection.
  6. The PCA units shall be protected against overheating when in the Heating mode. Protection shall be automatically resetting.
  7. The refrigeration system shall be protected against operation at abnormal refrigerant pressures by high and low pressure limit switches.
  8. The refrigerant compressor motors shall be protected against short-cycling. A timer shall be installed in the motor control circuit to provide an appropriate delay on re-energizing after each stop.
  9. Smoke Detector:
    - a. Each PCA unit shall be equipped with a factory installed and tested smoke detector.
    - b. The smoke detector shall be of the ionization type and shall be mounted at each PCA unit discharge plenum. The smoke detector shall interface with the PCA unit control circuitry. When sufficient smoke is sensed, the entire PCA unit shall shut down. A manual switch shall be utilized to reset the smoke detector.
    - c. A fault of the smoke detector itself shall also cause the entire unit to shut down and alarm.

## 1.22 FACTORY ACCEPTANCE TESTING

### A. Contractor's Factory Testing Plan

1. The Contractor and/or new equipment Manufacturer shall develop a Factory Testing Plan, as part of its overall Quality Plan, which identifies the specific testing to be done at the Contractor's and/or new equipment Manufacturer's factory. The Factory Tests must confirm, to the extent possible in Contractor's and/or new equipment Manufacturer's factory that all features, functions and capabilities of the

AGSE, as defined in the Specification and Contract Documents, are performing as intended. The Factory Test Plan shall be submitted with the Contractor's Quality Plan and approved by the Owner thirty (30) days prior to any Factory Tests being conducted.

2. It is the intent of the Owner that the Contractor and/or new equipment Manufacturer shall develop a comprehensive Factory Test Plan, identifying the specifics of the tests to be carried out, and the acceptance criteria of such test, to ensure the AGSE comply with the requirements of the Specification and Contract Documents.
3. Factory mass flow tests shall be conducted for each size of PCA units at design ambient conditions with a test apparatus whose resulting calculated mass flow has been certified by the NEBB or other approved Agency. The submittal for the PCA units shall include the agency certification report of the test apparatus, sealed, and authenticated by the agency.
4. Should factory tests fail to indicate compliance with specifications, all costs associated with re- testing, including costs associated with the Owner's witness services, will be the responsibility of the manufacturer.
5. Owner or his representative shall have the right to witness these tests, for which purpose a 5-day notification shall be given before performance.
6. Complete test reports shall be submitted within 2 weeks of factory test.
7. The first unit shall be type tested at actual design summer condition for capacity and performance.

### 1.23 ON-SITE FUNCTIONAL TESTING

#### A. Contractor's On-Site Testing Plan

1. The Contractor shall develop an On-Site Testing Plan, as part of its overall Quality Plan, which identifies the specific testing to be done by the Contractor after the AGSE are installed at IAH. The On-Site Testing must confirm that all of the AGSE function as intended, alone and in conjunction with each other and provide the required features, functions and capabilities as defined in the Specification and Contract Documents. The On-Site Test Plan shall be submitted with the Contractor's Quality Plan and approved by the Owner thirty (30) days prior to any On-Site Tests being conducted.
2. It is the intent of the Owner that the Contractor shall develop a comprehensive On-Site Test Plan, identifying the specifics of the tests to be carried out, and the acceptance criteria of such test, to ensure the AGSE comply with the requirements of the Specification and Contract Documents.
3. In-Process Field Testing and Inspection: All installed equipment shall be inspected, all wiring checked for proper continuity, and units checked for leaks in accordance with the applicable specs and standards.

4. On-Site Acceptance Tests: Recognizing that it is impractical to simultaneously duplicate the design ambient, aircraft activity, and passenger loads for performing system capacity, acceptance criteria for system rating will be based on certain capacity measurements and interpolation/extrapolation of data. These criteria and procedures will be mutually agreed to by the Supplier and Owner before the performance of the acceptance tests.
5. Following check out and inspection by the Supplier, a complete acceptance test shall be made of each gate system using live aircraft and shall be witnessed by the Owner.
6. Tests shall comprise those in the approved test procedure.
7. Complete test reports shall be submitted within 10 working days of completion of the actual tests.
8. Test reports shall contain suitable data reduction and calculation to verify the goals of the test plan and the system capacity.

#### 1.24 GENERAL QUALITY ASSURANCE REQUIREMENTS

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. The quality assurance requirements for this project shall focus on ensuring Contractor and/or new equipment Manufacturer refurbishes, designs, manufactures, delivers and installs the required equipment that fully complies with the requirements of this Specification.
- C. The quality assurance requirements shall consist of:
  1. The Contractor's and/or new equipment Manufacturer's Quality System – Consisting of the Contractor's and/or new equipment Manufacturer's Quality Manual and Quality Procedures
  2. The Contractor's and/or new equipment Manufacturer's Quality Plan – The Quality Plan developed by the Contractor and/or new equipment Manufacturer and to ensure all requirements of this Specification are met.
  3. Contract Review and Design - The Specification Compliance Document, drawings, cut sheets, calculations, third party certifications, test results, etc. submitted by the Contractor and/or Manufacturer for review and approval of the Owner.
  4. Contractor's and/or new equipment Manufacturer's Material Receipt, In-Process Manufacturing and Final Inspections – All receiving, in-process and final inspection documents and reports shall be submitted for review and approval of the Owner.
  5. Factory Acceptance Testing – The Contractor and/or new equipment Manufacturer Factory Acceptance Testing to ensure the new AGSE meets the design

requirements of this Specification. The Contractor shall submit reports of such acceptance testing for review and approval of the Owner.

6. Owner Inspection prior to Shipment – The Owner reserves the right to perform an in-factory inspection of all equipment PRIOR to shipment. This inspection shall review compliance to the Specifications and to ensure all equipment has passed Factory Acceptance Testing. Witness of certain Factory Acceptance Testing shall also be part of this in-factory inspection. Travel, lodging, per diem and other costs for the Owner's representatives to conduct any subsequent inspections required, should the equipment fail the initial inspection, shall be the responsibility of the Contractor.
7. Contractor's Installation In-Process and Punch List Completion Inspection – All Installation In-Process and Punch List Completion inspection documents and reports shall be submitted for review and approval of the Owner.
8. Owner in Process Installation Inspection – The Owner's representative will perform an in process inspection during the Installation process.
9. Functional Testing – As part of the installation process, the Contractor shall conduct Functional Testing to verify the equipment meets certain functional requirements of the Specification. All test reports from such Functional Testing shall be submitted to the Owner for review and approval.
10. Owner Final Inspection – The Owner's representative will perform a final inspection after Final Acceptance is achieved on all equipment. At this time, a Final Punch List will be generated, identifying all non-conformances with the AGSE and Services and the agreed upon date between the Owner and the Contractor for the Contractor to remedy all non-conformances.

#### 1.25 CONTRACTOR'S QUALITY PLAN

- A. The Contractor and/or new equipment Manufacturer shall develop a Quality Plan that identifies the relevant inspection points and acceptance criteria that will be utilized by the Contractor and/or new equipment Manufacturer to ensure all requirements of the Specification are met.
- B. The Quality Plan shall identify the inspection and review points during the contract review, design, manufacturing, and installation where the Contractor and/or new equipment Manufacturer will perform inspections or tests to ensure compliance to the Specifications.
- C. The Quality Plan shall identify the scope of the inspections and tests and the specific acceptance criteria that will be utilized by the Contractor and/or new equipment Manufacturer for each inspection and test.
- D. The Quality Plan shall also identify the test plan, procedures, methods, techniques, etc. that will be utilized by the Contractor and/or new equipment Manufacturer to conduct the required FACTORY ACCEPTANCE TESTING and ON-SITE FUNCTIONAL TESTING.

- E. The Contractor and/or the new equipment Manufacturer shall submit their Quality Plan to the Owner for approval within sixty (60) days of the issuance of the Notice to Proceed.

#### 1.26 NON-CONFORMING GOODS

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. The Owner has the right to disapprove or reject Goods or Services that the Owner believes to be non-conforming.
- C. If the Owner elects to reject the Goods or Services in whole or in part, Owner's notice to Contractor will describe in sufficient detail the non-conforming aspect of the Goods or Services. If Goods or Services have been delivered to Owner, Contractor shall promptly, and within the Contract Times, remove and replace or modify the rejected Goods or Services.
- D. Contractor shall bear all costs, losses, and damages attributable to the removal and replacement or modification of the non-conforming Goods or Services.
- E. Upon rejection of the Goods, Owner retains a security interest in the Goods and Services or to the extent of any payments made and expenses incurred in their testing and inspection.
- F. If the Owner elects to permit the Contractor to modify the Goods or Services to remove the non-conformance, Contractor shall promptly provide a schedule for such modifications and shall make the Goods or Services conforming within a reasonable time.
- G. Instead of requiring modification or removal and replacement of non-conforming Goods or Services discovered either before or after final payment, Owner may accept the non-conforming Goods or Services. Contractor shall bear all costs, losses, and damages attributable to Owner's evaluation of and determination to accept such non-conforming Goods or Services.
- H. Contractor shall pay all claims, costs, losses, and damages, including but not limited to all fees and charges for re-inspection, retesting and for any engineers, architects, attorneys and other professionals, and all court or arbitration or other dispute resolution costs arising out of or relating to the non-conforming Goods or Services, including the modification or removal and replacement of the non-conforming Goods or Services and the replacement of property of Owner and others destroyed by the modification or removal and replacement of the non-conforming Goods or Services, or the obtaining of conforming Goods or Services from others.
- I. Contractor's responsibility for correcting all non-conformities in the Goods and Services will extend for the Warranty Period as specified in the Contract Documents after the date of Final Acceptance of the Goods and Services, or for such longer period

of time as may be prescribed by Laws or Regulations or by the terms of any specific provisions of the Contract Documents.

- J. Neither payments made by Owner to Contractor prior to any tests or inspections, nor any tests or inspections shall constitute acceptance of non-conforming Goods, or prejudice Owner's rights under the Contract.

## 1.27 INSPECTIONS

### A. Factory Inspections

1. The Owner may conduct a Factory Inspection of the new AGSE at the manufacturing location and perform an inspection of the equipment and witness the AGSE tests as set forth in the specification and in the Contractor's and/or new equipment Manufacturer's approved Factory Test plan.
2. The Owner may send up to three (3) representatives to conduct the Factory Inspections.
3. The Contractor shall supply the Owner's inspection representatives with instruments, tools, and equipment and all such assistance as they may find necessary to conduct inspections of the equipment.
4. Contractor shall provide Owner 30-days written notice, prior to shipment, of the readiness of the AGSE for the Owner's inspection. All the AGSE shall be available for inspection and testing at the same time.
5. The Owner shall arrange and pay for all travel, lodging, local transportation, and local meals for the Owner's representatives attending the factory testing.
6. If, on the basis of the Factory inspections and testing, the AGSE appear to be conforming, Owner will give Contractor prompt notice thereof. If on the basis of the Factory inspection and testing, the AGSE appear to be non-conforming, Owner will give Contractor prompt notice thereof and will advise Contractor of the required remedies and if such remedies must be accomplished prior to shipment and if a subsequent inspection by the Owner's representatives will be required prior to shipment.
7. If subsequent factory inspections will be required, as determined by the Owner, the Contractor shall arrange and pay for all travel, lodging, local transportation, and local meals for the Owner's representatives (up to three (3)) to attend this factory re-inspection and re-testing.

### B. Inspection Upon Delivery

1. Contractor shall inspect the AGSE upon delivery solely for purposes of identifying the AGSE and general verification of quantities and observation of apparent condition in order to ensure AGSE are acceptable and suitable for installation. Such inspection will not be construed as final or as receipt of any AGSE and Services that, as a result of subsequent inspections and tests, are determined to be non-conforming.

2. Within three (3) days of such receiving inspections, Contractor shall provide Owner with written notice of Contractor's determination regarding conformity of the AGSE. In the event Contractor does not provide such notice, it will be presumed that the AGSE are suitable for Installation.

C. Inspection During Installation Process

1. The Owner's representative will conduct one or more inspections during the Installation process to review the Contractor's compliance with the Installation Specification and the rectification of any previously identified non-conformities. The Contractor shall supply the Owner's inspection representative with instruments and all such assistance as they may find necessary.
2. The Owner reserves the right to conduct these Installation inspections, unannounced and at any time during the Installation process.
3. If, on the basis of any inspections or testing, the AGSE or Services appear to be non-conforming, Owner will give Contractor prompt notice thereof will advise Contractor of the required remedies and the required completion date of such remedies.

D. Inspection at Final Acceptance

1. The Owner's representative will conduct a Final Acceptance Inspections when the Contractor has completed the Installation of the AGSE. The Owner's representative shall review all of the AGSE to ensure they are installed properly, that the Services have been completely carried out and that all previously identified non-conformities have been remedied. During this Final Acceptance Inspection, the Contractor shall conduct, with the Owner's representative as a witness, the specified on-site functional testing of the AGSE. The Owner's representative will identify any Punch List items that must be remedied by the Contractor during the Final Acceptance Inspection.
2. The Contractor shall provide seven (7) days written notice to the Owner of the proposed date of Final Acceptance and on-site functional testing.
3. If the AGSE are considered by the Owner to be Substantially Complete and useable for the intended purpose, the Contractor shall issue a Final Acceptance Certificate to the Owner. This Final Acceptance Certificate must list all identified Punch List items, must indicate a due date for the completion of the Punch List items, and must be approved by the Owner.
4. If the Contractor does not receive a signed Final Acceptance Certificate on the required date, as specified in the Contract Documents, the Owner may exercise delay penalties as called out in the Contract Documents.

E. Final Acceptance

1. Once the Contractor has remedied all of the Punch List items, the Owner shall be notified to re-inspect the AGSE and Services. Upon such notification, the Owner's representative shall re-inspect the AGSE and Services to verify the Punch List items have been remedied.



2. If any of the Punch List items have not been remedied to the Owner's satisfaction and subsequent inspections are required by the Owner's representative, the Contractor shall bear any and all costs, including labor, material, travel and per diem, incurred by the Owner to conduct such repeat FINAL ACCEPTANCE inspections.
3. If the Contractor does not remedy the Punch List items by the date identified on the Final Acceptance form, the Owner may exercise delay penalties as called out in the Contract Documents.
4. Once all Punch List items are remedied and accepted by the Owner, the Contractor shall issue a Final Acceptance Certificate, indicating the date the AGSE and Services have been accepted by the Owner. This date will also be the start date of the Contractor's Warranty Period.

END OF SECTION

## SECTION 347713.4 – POTABLE WATER CABINETS

### 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. Related Requirements and products not supplied under this section:
  - 1. Section 347713.1 Passenger Loading Bridges
  - 2. Section 347713.3 Aircraft Pre-Conditioned Air Units
  - 3. Section 347713.3 Aircraft Pre-Conditioned Air Units

#### 1.2 SUMMARY

- A. Work Includes designing, manufacturing, testing, furnishing, installing, and commissioning potable water cabinet and associated controls and accessory equipment.
- B. Unless noted otherwise on the drawings, the work shall include everything necessary or incidental to complete the installation including wire raceway (conduit), raceway fittings, outlet boxes, pull boxes, terminal cabinets, 120 volt AC power circuits, and insulated ground cables. Such equipment shall be furnished and installed as Division 26 electrical work. The Contractor shall furnish all necessary information to other contractor(s) to ensure that a proper conduit system will be installed. Provide accurate as-built drawings indicating all installed conduit and junction boxes.
- C. The Contractor shall cooperate with all other contractors engaged in this project and shall coordinate the aircraft ground power units installation so that all work will proceed in a manner which is in the best interests of the project.
- D. It is the purpose of this specification to require the furnishing of highest quality materials, equipment, and workmanship. The work shall be in accordance with this specification and conform to the designs, layouts, and descriptions on the drawings.

#### 1.3 DEFINITIONS

- A. "Aircraft Gate Support Equipment (AGSE)" or "Goods" shall mean various pieces of equipment that the Owner is procuring or supplying for installation for Houston Airport System (HAS). This equipment shall include the following:

1. "PLBs" shall mean the new Passenger Loading Bridges.
  2. "GPU" shall mean the new Ground Power Units.
  3. "PCA" shall mean the new aircraft Pre-Conditioned Air Units.
  4. "RTU" shall mean the PLBs cooling unit.
- B. "Authority" or "Airport" or "Owner" or "HAS" may be used interchangeably throughout this Specification and shall mean Houston Airport System.
- C. "Bidder" or "Contractor" or "Supplier" or "Offeror" or "Proposer" may be used interchangeably throughout this Specification and shall mean the individual, partnership, corporation, or other business entity that shall be supplying AGSE and Installation Scope of Work pursuant to this Specification.
- D. "HOU": William P. Hobby Airport. "IAH": George Bush Intercontinental Airport.
- E. Drawings: That part of the Contract Documents prepared or approved by the Owner that graphically shows the scope, intent, and character of the AGSE and Services to be furnished by Contractor.
- F. Project: The total undertaking of which the AGSE and Installation Scope of Work to be provided under the Contract are a part.
- G. Samples: Physical examples of materials, equipment, or workmanship that are representative of some portion or all of the AGSE and which establish the standards by which certain portions of the AGSE or Installation Scope of Work will be judged.
- H. Services: The Scope of Work performed at HOU and IAH.
- I. Shop Drawings: All drawings, diagrams, illustrations, schedules, test reports, certifications, cut sheets, calculations and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to demonstrate that the Contractor will provide AGSE and Installation Scope of Work which meet the requirements of the Specifications.
- J. Specifications: Shall mean these Technical Specifications and related Contract Documents.

#### 1.4 INTENT OF CERTAIN TERMS OR ADJECTIVES

- A. The Contract Documents include the terms "as allowed", "as approved", "as ordered", "as directed", or terms of like effect or import to authorize an exercise of professional judgment by the Owner. In addition, the adjectives "reasonable", "suitable", "acceptable", "proper", "satisfactory", or adjectives of like effect or import are used to describe an action or determination of Owner as to the suitability of the Materials used to manufacture new AGSE. It is intended that such exercise of professional judgment, action or determination will be solely to evaluate, in general, the AGSE for compliance with the requirements of and information in the Contract Documents and conformance

with the design concept of the completed Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective shall not be effective to assign to Owner any duty or authority to supervise or direct the furnishing of AGSE or any duty or authority to undertake responsibility contrary to any other provision of the Contract Documents.

- B. Unless stated otherwise in the Contract Documents, words or phrases which have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.
- C. The word "non-conforming", when modifying the word AGSE or Goods, refers to AGSE that fail to conform to the requirements of the Specifications, written Amendments, Change Orders and written clarifications or interpretations issued by the Owner.
- D. The word "day" or "days" shall constitute a calendar day of 24 hours measured from midnight to the next midnight. When a numeric indication is given for a number of "days", it shall mean calendar days, not work weekdays.

#### 1.5 GENERAL

- A. The term "Potable Water Cabinet" as used within this specification and throughout the contract documents is understood to mean the components, subcomponents and subsystems that constitute a complete, operable, and maintainable Potable Water Cabinet and as referred to herein, are synonymous.
- B. The terms, "Seller", "Contractor", "Provider", and "Manufacturer" as referred to herein, are synonymous.
- C. Applicable contract and terminal building drawings will be made available upon written request.
- D. The Potable Water Cabinet and all components thereof shall be constructed in accordance with all codes and standards and local laws and regulations applicable to the design and construction of this type of equipment, which are generally accepted and used as good practice throughout the industry, including without limitation, NFPA, Underwriter's Laboratories, OSHA, SAE Publications, American National Standards, Military Standards, etc. The design of all parts and subassemblies shall be in accordance with good commercial practice and shall be the responsibility of the manufacturer to assure safe, efficient and practical design in keeping with requirements peculiar to this type system.
- E. Coordinate with the PLB, GPU, and PCA equipment for the provisions for, or installation of, all necessary infrastructure. The Owner must approve any exceptions.
- F. Acceptable Potable Water Cabinet manufacturers shall be:
  - 1. Semler Industries, Inc.

2. Phoenix Metal Products
  3. Substitutions – Reference Division 01 - General Requirements
- G. The Owner, or Owner's tenant, reserves the right to provide branding on the exterior sides of the installed equipment and desires that this branding not be diminished by excessively large or aesthetically displeasing branding of individual pieces of equipment. All manufacturers branding, labeling, marking, etcetera, on their products shall be small compared to the overall size of the device. All branding shall be submitted for approval. The Owner reserves the right to require any non-approved branding be removed from finished products at no additional cost.
- H. The manufacturer shall be a qualified source, who has been regularly engaged in the engineering, manufacturing, and installation of commercial aviation Potable Water Cabinet equipment and components for a minimum of five (5) years and with a minimum of one hundred (100) units installed.
- I. Qualified manufacturers and installers will have completed no less than (5) jobs of similar size and scope within the last five (5) years.
- J. The manufacturer shall have proven technical capabilities and adequate manufacturing facilities together with sufficient financial depth and stability to permit prompt and satisfactory execution of the contract.
- K. Manufacturers are required to satisfy all requirements of this specification and the HAS Design Standards Manual which is available on the HAS website. Should the Manufacturer desire to deviate from any portion, either because the specification or manual is in error, violation of any law or regulation, or is in need of modification to permit a more satisfactory functional and economical design, they must submit a written request for such deviation. The Manufacturer shall not contract, purchase, or cause to be delivered, equipment which does not meet all requirements of this document as specified, without obtaining prior written approval.
- L. The Manufacturer shall be responsible for verifying installation locations and methods and shall notify the Owner of any conflicts or code violations prior to manufacture of the Potable Water Cabinet units. Verifications shall include field verifications of terminal building heights, appurtenances, and finishes, including terminal doors; electrical, mechanical, special systems, and communications interfaces; as well as Potable Water Cabinet mounting provisions and details. Modifications to eliminate conflicts or code violations will be coordinated with and approved by the Owner. Modifications shall be made at no additional cost to the Owner.
- M. The Manufacturer shall furnish and install all necessary equipment to provide a complete, operable, and maintainable unit.
- N. Schedule: See contract drawings for locations/types of Potable Water Cabinets.
- O. Should alternate mounting configurations or physical attributes, other than those specified herein, or indicated on the project drawings, be proposed, manufacturers shall submit alternates

## 1.6 PROJECT SCOPE

- A. Supply, installation, and twenty-five (25) years turn-key maintenance of new PLBs, GPUs, PCAs, Potable Water Cabinets, and RTUs at HOU and IAH, including all related engineering, design, refurbishment, testing, manufacturing, fabrication, assembly, deliveries, spare parts, training, manuals, special tools, obtaining contract bonds & insurances, shipping charges, installation costs, and any other work related to completion of this contract.
- B. The project will include the removal and scrap of the existing AGSE at HOU and IAH.

## 1.7 PROGRESS SCHEDULE

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. The work under this Contract shall be complete as specified below.
- C. The new Potable Water Cabinets shall be delivered, installed, and commissioned no later than date specified in the Contract documents.
- D. Within fifteen (15) days after the Notice to Proceed is issued to the Contractor, the Contractor shall submit to Owner an acceptable Progress Schedule of Project activities; including at a minimum:
  - 1. Design, Engineering, Preparation, and Submittal of all Shop Drawings. Note – Shop Drawings are inclusive of ALL submittal requirements, as set forth in these Specifications.
  - 2. Owner's review and approval of Shop Drawings
  - 3. Material Procurement
  - 4. Manufacture of Potable Water Cabinets
  - 5. Contractor's Factory Tests
  - 6. Factory Tests to be witnessed by Owner, at Owner's discretion
  - 7. Shipping and Delivery
  - 8. Removal and Scrap of Existing Potable Water Cabinets (when applicable)
  - 9. Installation, testing, and commissioning of new AGSE
- E. The Progress Schedule shall be in Gantt Chart format and be developed utilizing MS Projects Software or other Project Scheduling Software approved by the Owner.
- F. The Progress Schedule will be acceptable to Owner if it provides an orderly progression of the submittals, tests, and deliveries to completion within the specified Milestones and the Contract Times. Such acceptance will not impose on Owner

responsibility for the progress schedule, for sequencing, scheduling, or progress of the work nor interfere with or relieve Contractor from Contractor's full responsibility, therefore. Such acceptance shall not be deemed to acknowledge the reasonableness and attainability of the schedule.

#### 1.8 SHIPPING AND DELIVERY

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. Contractor shall select the carrier and bear all costs of packaging, transportation, insurance, special handling, and any other costs associated with shipment and delivery.
- C. Contractor shall deliver the new AGSE, F.O.B. Point of Destination, in accordance with the Contract Times set forth in the Contract Documents, or other date agreed to by Owner and Contractor.
- D. Contractor shall provide written notice to Owner at least fifteen (15) days before shipment of the manner of shipment and the anticipated delivery date. Contractor shall also require the carrier to give Owner at least twenty-four (24) hours' notice by telephone prior to the anticipated hour of delivery.
- E. Delivery shall be made to:
  - 1. HOU
  - 2. IAH

#### 1.9 PROJECT MEETINGS AND COORDINATION

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. The Contractor's Project Manager shall schedule, attend, and conduct such Project Meetings as required to:
  - 1. Ensure the Project is executed successfully.
  - 2. Ensure that all parties are fully informed of Project requirements, issues, conflicts, clarifications, interpretations, etc.
  - 3. Resolve any discrepancies or disputes between the Owner and the Contractor.
- C. Travel and per diem costs for any of the Contractor's or their subcontractor's personnel required to travel to HOU or IAH, in any capacity, associated with the Project, and shall be the sole responsibility of the Contractor.

- D. The Contractor's Project Manager shall issue a Monthly Project Status Report to the Owner's designated representative by the fifth (5th) day of each month. This Status report shall include at a minimum, but is not limited to:
1. Current progress against the Contractor's Schedule.
  2. Current status of all Contractor Submittals.
  3. Any open, unresolved issues or clarifications the Contractor is awaiting a response from the Owner.

#### 1.10 TRAINING

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. The Contractor shall provide separate AGSE Operations and Maintenance classes. These classes will be conducted on-site and shall occur prior to Final Acceptance of the equipment installation.
- C. There shall be a minimum of two AGSE Operations classes which shall include a classroom training course followed by a field training course including allowing each attendee to operate the AGSE and ask questions related to the operations.
- D. There shall be a minimum of one AGSE Maintenance class which shall include a classroom training course followed by a field training course including allowing each attendee to see typical maintenance activities and ask questions related to the maintenance.
- E. Contractor shall submit a Training Syllabus for all training classes to be conducted within thirty (30) days of the Notice to Proceed. Format and content of Contractor's proposed Training classes shall be subject to approval of the Owner.

#### 1.11 SPARE PARTS

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. The Contractor shall provide a recommended spare parts list for spare parts that may be required during first two years of normal operation of the AGSE. This recommended Spare Parts List shall be provided prior to the shipment of the new AGSE.
- C. This recommended spare parts lists shall include the manufacturer's item description, part number, assemblies per unit, the recommended on-hand stocking level, and the current list price.



## 1.12 WARRANTY

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. Contractor warrants and guarantees to Owner that the title to new AGSE conveyed shall be proper, its transfer rightful, and free from any security interest, lien, or other encumbrance.
- C. Contractor warrants and guarantees to Owner that the new AGSE conforms to the requirements of the Contract Documents, including this Specification and any samples and Shop Drawings approved by Owner.
- D. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
  - 1. abuse, improper modification or improper maintenance or operation by persons other than Contractor; or
  - 2. normal wear and tear under normal usage.
- E. Contractor's obligation to furnish the new AGSE in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of new AGSE that are non-conforming, or a release of Contractor's obligation to furnish the new AGSE in accordance with the Contract Documents:
  - 1. observations by Owner;
  - 2. recommendation by Owner or payment by Owner of any progress or final payment;
  - 3. use of the new AGSE by Owner;
  - 4. any acceptance by Owner or any failure to do so;
  - 5. the issuance of a Final Acceptance notice by Owner; or
  - 6. any inspection, test or approval by Owner or Owner's representatives.
- F. Owner shall within a reasonable time notify Contractor of any breach of Contractor's warranties or guarantees. If Owner receives notice of a suit or claim as a result of such breach, Owner also may give Contractor notice in writing to defend such suit or claim. If Contractor fails to defend such suit or claim, Contractor will be bound in any subsequent suit or claim against Contractor by Owner by any factual determination in the prior suit.
- G. The Contractor warrants to the Owner that all materials (namely the new AGSE) furnished under this Contract shall be of good quality, free from faults and defects and in conformance with Contract requirements. Any work not so conforming to these standards may be considered defective. If, within one (1) year after the date of Owner's final acceptance of the work, the new AGSE are found to be defective or not in accordance with Contract requirements, the Contractor shall correct it at no cost to the Owner within five (5) days after receipt of written notice from the Owner to do so.

- H. For any new Potable Water Cabinets supplied for this Project, the Contractor shall provide:
  - 1. An extended 2-year Warranty from final acceptance agreeing to replace, repair, or restore any defective materials and workmanship of the AGSE.
  - 2. These extended warranties shall be in addition to, and not a limitation of, other rights the Owner may have against the Contractor under the Contract Documents.
- I. The Contractor shall supply Warranty Certificates, in favor of the Owner for all AGSE supplied under this Contract. Such Warranty Certificates shall be supplied with the Final Payment Application.
- J. The Contractor shall supply the Manufacturer's Warranty Certificates, in favor of the Owner, for all new AGSE supplied under this Contract. Such Warranty Certificates shall be supplied with the Final Payment Application.
- K. The Warranty obligations of the Contractor defined herein shall not be limited by any obligations otherwise prescribed by law.
- L. Upon Final Acceptance of the new AGSE, the Contractor shall furnish a good and sufficient Warranty / Maintenance Bond, in the sum of not less than 100% of the Contract amount, guaranteeing that that Contractor will faithfully fulfill the Warranty obligations of the Contract. Such bond shall remain in effect at least one year after the date of final acceptance, except as required by additional warranty and guarantee periods stipulated by Laws or Regulations.

#### 1.13 MANUALS

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. One searchable electronic and three (3) copies of the new AGSE OEM's O&M manuals shall be provided prior to the AGSE O&M training.

#### 1.14 MATERIALS

- A. Unless otherwise indicated, it is understood and agreed that ANY materials used or otherwise incorporated into the installation of the AGSE or in the manufacture of the AGSE by the Contractor shall be NEW and UNUSED. If required by the Owner, the Contractor will furnish satisfactory evidence as to the kind and quality of materials and equipment.
- B. Whenever an item of material or equipment to be incorporated into the new AGSE is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Contractor or manufacturer, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words

reading that no like, equivalent, or “or equal” item is permitted, other items of material or equipment or material or equipment of other suppliers or manufacturers may be submitted to Owner for review and approval.

1. If in Owner’s sole discretion, such an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related work will be required, it may be considered by Owner as an “or equal” item.
  2. For the purposes of this clause, a proposed item of material or equipment may be considered functionally equal to an item so named if:
    - a. in the exercise of reasonable judgment, Owner determines that:
      - 1) it is at least equal in quality, durability, appearance, strength, and design characteristics; and
      - 2) it will reliably perform at least equally well the function imposed by the design concept of the completed Project as a functioning whole; and
    - b. Contractor certifies that:
      - 1) there is no increase in any cost including capital, installation or operating to Owner; and
      - 2) the proposed item will conform substantially, even with deviations, to the detailed requirements of the item named in the Contract Documents.
- C. The Owner will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Paragraph 2 above. Owner will be the sole judge of acceptability. No “or equal” will be ordered, manufactured, or utilized until Owner’s review is complete, which will be evidenced by an approved Shop Drawing. Owner will advise Contractor in writing of any negative determination. Notwithstanding Owner’s approval of an “or equal” item, Contractor shall remain obligated to comply with the requirements of the Contract Documents.
- D. The Owner may require Contractor to furnish at Contractor’s expense a special performance guarantee or other surety with respect to any such proposed “or-equal.”
- E. Contractor shall provide all data in support of any such proposed “or equal” at Contractor’s expense.

#### 1.15 APPLICABLE CODES AND STANDARDS

- A. The Potable Water Cabinets and all of the accessories and mounting brackets and hardware shall be designed and manufactured to meet U.S. Codes and Regulations that have been adopted by the Potable Water Cabinets industry. Portions or all of certain recognized industry or association standards referred to herein as being a requirement of these Specifications shall be considered as binding as though the reproduced in full herein unless supplemented and/or modified by more stringent

requirements in this Specification. Unless otherwise stated, the reference standard shall be the standard which is current as of the date of issuance of these Specifications.

B. Applicable Industry and Association Standards:

1. Directives and Memoranda of the Department of Buildings
2. Americans with Disabilities Act (ADA)
3. The potable water cabinet, hose, nozzle, and all accessories shall be compliant with NSF 61
4. The potable water cabinet manufacturer will follow current regulations developed by the Airline Drinking Water Rule (ADWR), the Environmental Protection Agency (EPA), the Food and Drug Administration (FDA), and the Federal Aviation Administration (FAA)
5. NEMA - National Electrical Manufacturer's Association
6. Houston Airport System (HAS) Design Standards Manual

1.16 SUBMITTALS

A. Bid-Submittals: The following submittals shall be included with bid.

1. Alternates.
2. Spare Parts List: Provide manufacturer's recommended spare parts list.
3. UL Certifications.

B. Pre-Manufacture Submittals: The following submittals shall be made as necessary to meet the project schedule and shall be submitted and approved prior to manufacturing the potable water cabinet units.

1. Product data for selected models including specialties, accessories, and the following:
  - a. Hose reel, hose, light, heater, and other appurtenances.
  - b. Materials, gauges, and finishes.
2. Shop Drawings: Provide schematics and interconnection diagrams, indicate front and side views of enclosures with overall dimensions and weights shown; pipe/conduit/cable entrance locations and requirements; and nameplate legends. Differentiate between manufacturer-installed wiring and field-installed connections. Include appurtenances as required.
3. Installation Details: Provide complete installation details including, without limitation, installation details of all appurtenances. Show installed configuration as well as any pertinent details regarding interface to other equipment and systems, include electrical connection service points.

4. Resume or CV of manufacturers project manager.
- C. Pre-Ship Submittals: The following shall be submitted and approved prior to shipping potable water cabinet units to the project site:
1. Factory Acceptance Testing Reports: Indicate factory acceptance tests and results and inspection procedures.
  2. Installation Subcontractor and resume or CV of Installation Site Manager.
  3. Written Notice to Owner of scheduled delivery date and time at least 15 days prior to shipment.
- D. Pre-Substantial Completion Submittals: The following submittals shall be submitted and approved prior to 14 days before substantial completion, unless otherwise noted herein.
1. Operation and Maintenance Manuals.
  2. Training Program: At least 60 days prior to substantial completion, a training program summary, course syllabus, instructor qualifications, and copy of the training manual shall be submitted for review and approval.
  3. On-Site Functional Testing Report: Submit proposed on-site functional testing report for approval.
- E. Pre-Final Acceptance Submittals: The following submittals shall be submitted and approved prior to 14 days before final acceptance.
1. As-Built Drawings. Provide field edited redlined project drawings showing deviations from design documents.
  2. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and have been registered with the manufacturer.
  3. On-Site Functional Testing Report: A completed field on-site functional testing report for each installed unit as specified herein. Utilize approved form.
  4. Training Rosters. Provide training roster with trainee names, dates, and types of training, as well as durations.
  5. Original software and documentation registered in the Owner's name.
  6. Hard copy and electronic version (compact disk or flash card) copies of all programs and settings loaded into equipment provided hereunder.

#### 1.17 AIRCRAFT MIX

- A. The Potable Water Cabinets must be capable of servicing the aircraft mix as identified in the Project Drawings.

## 1.18 SYSTEM PERFORMANCE REQUIREMENTS

### A. Basic Function

1. The construction of the AGSE will include a Potable Water Cabinet. The construction will provide adequate means to deliver potable water to the complete mix of potential aircraft that can be serviced at each gate area. The system design shall consider user efficiencies, ergonomics, environmental impact, ease of maintenance and possible future gating scenarios. The potable water hose connectors must be compatible with all gated aircraft, both current and future. The flow rate and pressure shall meet aircraft manufacturers and airline specifications and provide the specified levels of operational performance and customer service for the handling of aircraft while parked at the gate.
- B. The potable water cabinet shall be mounted to the left side of the PLB at the vertical lift column / drive wheels. The mounting location shall not conflict with the mating of the PLB to any aircraft type.

## 1.19 UNIT COMPONENTS

### A. Cabinet

1. Material: Stainless steel, type 304, 16 gauge, #4 polish finish interior and exterior.
2. Construction: Welded double wall construction through-out, including bottom and doors with one inch polystyrene insulation. Welded and ground joints; brushed and polished interior and exterior. Cabinet provided with:
  - a. 1-1/2" FNPT fitting for drain (located at the bottom right side of cabinet)
  - b. 1" MNPT stub for water inlet connection (located at the outside back wall of cabinet)
  - c. Multiple knockouts are provided on the power disconnect which is located on the outside back wall of cabinet.
    - 1) No support braces or equipment mounted on the bottom of the cabinet to impede drainage or cabinet cleaning.

### B. Doors

1. Material: Stainless steel, type 304, 16 gauge, #4 finish polish interior and exterior.
2. Construction shall be double wall construction, welded and ground joints with brushed and polished interior and exterior. Two-point latch with recessed stainless steel locking handle and full length stainless steel piano hinges with top mounted stainless steel door holder/closer shall be provided. Door hinges shall be mechanically fastened to cabinet body for ease in removal for maintenance or replacement. Automotive grade weather stripping shall be installed on door jambs to minimize heat loss.

### C. Electrical

1. All components mounted within the cabinet shall be UL listed or recognized, weather resistant or NEMA 4 rated, suitable for service at 120 VAC. All parts shall be grounded.
2. Light: 100 watt equivalent LED, 120VAC, enclosed, with gasket and suitable for use in wet locations with clear (heat resistant) globe, aluminum guard and ON-OFF switch.
3. Heaters: Four (4) 600 watt, 120 VAC heat pads with temperature limit switch located behind removable insulated side panels. Controlled by one (1) NEMA 4X adjustable thermostat set at 50°F with positive on-off switch.
4. All wiring shall be enclosed in flexible Seal Tite conduit or rigid galvanized conduit. Two (2) 120 VAC, 1 Phase circuits are required for each cabinet. Heaters are on one (1) 25 AMP circuit. Motor and light on one (1) 15 AMP circuit.
5. A motorized hose reel shall be provided to easily retract the hose into the cabinet. The hose reel capacity shall be such that it can accommodate 300 feet of ¾" ID or 200 feet of 1" ID hose.
6. Hose Reel: Hannay model no. SIRXX60-0138 with 1" bronze swivel joint with food-grade grease, stainless steel piping, aluminum drum, stainless steel disks and frame. Hose reel motor chain shall be covered by a stainless steel removable guard. Reel includes 0.4 HP, 115 volt, explosion-proof electric rewind motor with horsepower rated momentary contact control switch. Auxiliary hand rewind crank and adjustable reel drag brake shall be included. A four way hose roller guide shall be provided to assist in rewinding hose evenly. Reel shall be mounted to vertical rear wall of cabinet.
7. A low cabinet temperature warning beacon shall be located on top outside of cabinet and shall be activated when the interior cabinet temperature falls below 35 degrees F.
8. A "Heat On" indicator pilot light shall be located inside the cabinet on the terminal box cover and shall be activated when the thermostat is calling for heat.
9. A three pole, NEMA 3R, 30 amp fused power disconnect shall be mounted to the exterior outside back wall of the cabinet.
10. A 120 VAC, 15 amp. GFCI service outlet, weather tight cover shall be mounted on the exterior of the cabinet.

D. Piping Components

1. Nozzle: Semler nozzle MPN L580-215-3409 or Edmik nozzle MPN E-PWC-1000, long barrel coupler with plug/drag cushion, stainless steel nylon coated security cable, control valve and protective 6" rubber bumpers, thick wall aluminum coupler with stainless steel ball cage.
2. Shut-off Valve: 1" bronze ball valve, Teflon seat, stainless steel ball.
3. Pressure Regulator: Conbraco # 36-105 1" bronze, adjustable 25-75 PSI.

4. Pressure Gauge: 2-1/2", 0-100 PSI bronze internals, polished brass case. "CALIBRATION NOT REQUIRED" sticker on the gauge.
5. Piping: Pipe and fittings to be brass or bronze threaded and suitable for potable water service. Provisions to be provided in cabinet piping to allow for sanitizing of cabinet piping and hose.
6. Connector: 1" X 8" flexible stainless steel connector to relieve piping stress
7. Hose: 3/4" x 300' drinking water hose in compliance with FDA-CFR title #21 parts #170-199 and NSF 51 & 61 standards no substitute.
8. Air gap with male coupling and drain piping (installed inside cabinet for manual flushing).
9. RPZ type backflow preventer installed in cabinet piping.
10. Filter: 5-micron high flow replaceable cartridge filter.
11. IntelliFlush: Self flushing circuit for automatic purging of stagnant water when the cabinet is inactive.

E. Miscellaneous

1. Cabinet shall be NRTL listed and marked accordingly.
2. Cabinet is tested by a third-party testing agency for freeze protection. The testing verifies that at test room conditions of -40°F and with the heating thermostat set at 50°F, the interior of the cabinet will sustain a minimum temperature of 34°F at the water inlet of the hose reel.
3. Signage – "POTABLE WATER" engraved placard with weather resistant materials fastened to outside doors with corrosion resistant fasteners. Potable Water Instructions located inside door.
4. Complete manual to include operation instructions, maintenance procedures, overhaul/repair, illustrated parts list, and troubleshooting guide.
5. Each potable water cabinet shall be supplied with 480V, 60Hz, 3PH power by a feeder cable that is attached to and runs from the terminal building down the outside of the PBB.
6. Each potable water cabinet shall be supplied with a potable water supply line that is attached to and runs from the terminal building.
7. Water controls shall be adjustable 20-70 PSI pressure regulator with 1" shut-off valve and pressure gauge.
8. The potable water cabinet shall be designed for a moderate-weather operation.

F. Health and Safety

1. Fire Safety: The construction will provide fire protection systems to protect life and property in accordance with all current codes and project requirements.



2. Ergonomic Requirements: Ergonomic considerations shall be in accordance with ground handler, maintenance provider and airline requirements.

## 1.20 FACTORY ACCEPTANCE TESTING

### A. Contractor's Factory Testing Plan

1. The Contractor and/or new equipment Manufacturer shall develop a Factory Testing Plan, as part of its overall Quality Plan, which identifies the specific testing to be done at the Contractor's and/or new equipment Manufacturer's factory. The Factory Tests must confirm, to the extent possible in Contractor's and/or new equipment Manufacturer's factory that all features, functions and capabilities of the AGSE, as defined in the Specification and Contract Documents, are performing as intended. The Factory Test Plan shall be submitted with the Contractor's Quality Plan and approved by the Owner thirty (30) days prior to any Factory Tests being conducted.
2. It is the intent of the Owner that the Contractor and/or new equipment Manufacturer shall develop a comprehensive Factory Test Plan, identifying the specifics of the tests to be carried out, and the acceptance criteria of such test, to ensure the AGSE comply with the requirements of the Specification and Contract Documents.
3. Owner or his representative shall have the right to witness these tests, for which purpose a 5-day notification shall be given before performance.
4. Complete test reports shall be submitted within 2 weeks of factory test.
5. The first unit shall be type tested at actual design summer condition for capacity and performance.

## 1.21 ON-SITE FUNCTIONAL TESTING

### A. Contractor's On-Site Testing Plan

1. The Contractor shall develop an On-Site Testing Plan, as part of its overall Quality Plan, which identifies the specific testing to be done by the Contractor after the AGSE are installed at IAH. The On-Site Testing must confirm that all of the AGSE function as intended, alone and in conjunction with each other and provide the required features, functions and capabilities as defined in the Specification and Contract Documents. The On-Site Test Plan shall be submitted with the Contractor's Quality Plan and approved by the Owner thirty (30) days prior to any On-Site Tests being conducted.
2. It is the intent of the Owner that the Contractor shall develop a comprehensive On-Site Test Plan, identifying the specifics of the tests to be carried out, and the acceptance criteria of such test, to ensure the AGSE comply with the requirements of the Specification and Contract Documents.

3. In-Process Field Testing and Inspection: All installed equipment shall be inspected, all wiring checked for proper continuity, and units checked for leaks in accordance with the applicable specs and standards.
4. On-Site Acceptance Tests: Recognizing that it is impractical to simultaneously duplicate the design ambient, aircraft activity, and passenger loads for performing system capacity, acceptance criteria for system rating will be based on certain capacity measurements and interpolation/extrapolation of data. These criteria and procedures will be mutually agreed to by the Supplier and Owner before the performance of the acceptance tests.
5. Following check out and inspection by the Supplier, a complete acceptance test shall be made of each gate system using live aircraft and shall be witnessed by the Owner.
6. Complete test reports shall be submitted within 10 working days of completion of the actual tests.
7. Test reports shall contain suitable data reduction and calculation to verify the goals of the test plan and the system capacity.

#### 1.22 GENERAL QUALITY ASSURANCE REQUIREMENTS

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. The quality assurance requirements for this project shall focus on ensuring Contractor and/or new equipment Manufacturer refurbishes, designs, manufactures, delivers and installs the required equipment that fully complies with the requirements of this Specification.
- C. The quality assurance requirements shall consist of:
  1. The Contractor's and/or new equipment Manufacturer's Quality System – Consisting of the Contractor's and/or new equipment Manufacturer's Quality Manual and Quality Procedures
  2. The Contractor's and/or new equipment Manufacturer's Quality Plan – The Quality Plan developed by the Contractor and/or new equipment Manufacturer and to ensure all requirements of this Specification are met.
  3. Contract Review and Design - The Specification Compliance Document, drawings, cut sheets, calculations, third party certifications, test results, etc. submitted by the Contractor and/or Manufacturer for review and approval of the Owner.
  4. Contractor's and/or new equipment Manufacturer's Material Receipt, In-Process Manufacturing and Final Inspections – All receiving, in-process and final inspection documents and reports shall be submitted for review and approval of the Owner.

5. Factory Acceptance Testing – The Contractor and/or new equipment Manufacturer Factory Acceptance Testing to ensure the new AGSE meets the design requirements of this Specification. The Contractor shall submit reports of such acceptance testing for review and approval of the Owner.
6. Owner Inspection prior to Shipment – The Owner reserves the right to perform an in-factory inspection of all equipment PRIOR to shipment. This inspection shall review compliance to the Specifications and to ensure all equipment has passed Factory Acceptance Testing. Witness of certain Factory Acceptance Testing shall also be part of this in-factory inspection. Travel, lodging, per diem and other costs for the Owner’s representatives to conduct any subsequent inspections required, should the equipment fail the initial inspection, shall be the responsibility of the Contractor.
7. Contractor’s Installation In-Process and Punch List Completion Inspection – All Installation In-Process and Punch List Completion inspection documents and reports shall be submitted for review and approval of the Owner.
8. Owner in Process Installation Inspection – The Owner’s representative will perform an in process inspection during the Installation process.
9. Functional Testing – As part of the installation process, the Contractor shall conduct Functional Testing to verify the equipment meets certain functional requirements of the Specification. All test reports from such Functional Testing shall be submitted to the Owner for review and approval.
10. Owner Final Inspection – The Owner’s representative will perform a final inspection after Final Acceptance is achieved on all equipment. At this time, a Final Punch List will be generated, identifying all non-conformances with the AGSE and Services and the agreed upon date between the Owner and the Contractor for the Contractor to remedy all non-conformances.

#### 1.23 CONTRACTOR’S QUALITY PLAN

- A. The Contractor and/or new equipment Manufacturer shall develop a Quality Plan that identifies the relevant inspection points and acceptance criteria that will be utilized by the Contractor and/or new equipment Manufacturer to ensure all requirements of the Specification are met.
- B. The Quality Plan shall identify the inspection and review points during the contract review, design, manufacturing, and installation where the Contractor and/or new equipment Manufacturer will perform inspections or tests to ensure compliance to the Specifications.
- C. The Quality Plan shall identify the scope of the inspections and tests and the specific acceptance criteria that will be utilized by the Contractor and/or new equipment Manufacturer for each inspection and test.
- D. The Quality Plan shall also identify the test plan, procedures, methods, techniques, etc. that will be utilized by the Contractor and/or new equipment Manufacturer to

conduct the required FACTORY ACCEPTANCE TESTING and ON-SITE FUNCTIONAL TESTING.

- E. The Contractor and/or the new equipment Manufacturer shall submit their Quality Plan to the Owner for approval within sixty (60) days of the issuance of the Notice to Proceed.

#### 1.24 NON-CONFORMING GOODS

- A. The requirements listed below are in addition to those specified in DIVISION 1 of Contract Documents. If there is any conflict between these requirements and the requirements in DIVISION 1, the requirements of DIVISION 1 shall take precedence.
- B. The Owner has the right to disapprove or reject Goods or Services that the Owner believes to be non-conforming.
- C. If the Owner elects to reject the Goods or Services in whole or in part, Owner's notice to Contractor will describe in sufficient detail the non-conforming aspect of the Goods or Services. If Goods or Services have been delivered to Owner, Contractor shall promptly, and within the Contract Times, remove and replace or modify the rejected Goods or Services.
- D. Contractor shall bear all costs, losses, and damages attributable to the removal and replacement or modification of the non-conforming Goods or Services.
- E. Upon rejection of the Goods, Owner retains a security interest in the Goods and Services or to the extent of any payments made and expenses incurred in their testing and inspection.
- F. If the Owner elects to permit the Contractor to modify the Goods or Services to remove the non-conformance, Contractor shall promptly provide a schedule for such modifications and shall make the Goods or Services conforming within a reasonable time.
- G. Instead of requiring modification or removal and replacement of non-conforming Goods or Services discovered either before or after final payment, Owner may accept the non-conforming Goods or Services. Contractor shall bear all costs, losses, and damages attributable to Owner's evaluation of and determination to accept such non-conforming Goods or Services.
- H. Contractor shall pay all claims, costs, losses, and damages, including but not limited to all fees and charges for re-inspection, retesting and for any engineers, architects, attorneys and other professionals, and all court or arbitration or other dispute resolution costs arising out of or relating to the non-conforming Goods or Services, including the modification or removal and replacement of the non-conforming Goods or Services and the replacement of property of Owner and others destroyed by the modification or removal and replacement of the non-conforming Goods or Services, or the obtaining of conforming Goods or Services from others.

- I. Contractor's responsibility for correcting all non-conformities in the Goods and Services will extend for the Warranty Period as specified in the Contract Documents after the date of Final Acceptance of the Goods and Services, or for such longer period of time as may be prescribed by Laws or Regulations or by the terms of any specific provisions of the Contract Documents.
- J. Neither payments made by Owner to Contractor prior to any tests or inspections, nor any tests or inspections shall constitute acceptance of non-conforming Goods, or prejudice Owner's rights under the Contract.

## 1.25 INSPECTIONS

### A. Factory Inspections

- 1. The Owner may conduct a Factory Inspection of the new AGSE at the manufacturing location and perform an inspection of the equipment and witness the AGSE tests as set forth in the specification and in the Contractor's and/or new equipment Manufacturer's approved Factory Test plan.
- 2. The Owner may send up to three (3) representatives to conduct the Factory Inspections.
- 3. The Contractor shall supply the Owner's inspection representatives with instruments, tools, and equipment and all such assistance as they may find necessary to conduct inspections of the equipment.
- 4. Contractor shall provide Owner 30-days written notice, prior to shipment, of the readiness of the AGSE for the Owner's inspection. All the AGSE shall be available for inspection and testing at the same time.
- 5. The Owner shall arrange and pay for all travel, lodging, local transportation, and local meals for the Owner's representatives attending the factory testing.
- 6. If, on the basis of the Factory inspections and testing, the AGSE appear to be conforming, Owner will give Contractor prompt notice thereof. If on the basis of the Factory inspection and testing, the AGSE appear to be non-conforming, Owner will give Contractor prompt notice thereof and will advise Contractor of the required remedies and if such remedies must be accomplished prior to shipment and if a subsequent inspection by the Owner's representatives will be required prior to shipment.
- 7. If subsequent factory inspections will be required, as determined by the Owner, the Contractor shall arrange and pay for all travel, lodging, local transportation, and local meals for the Owner's representatives (up to three (3)) to attend this factory re-inspection and re-testing.

### B. Inspection Upon Delivery

- 1. Contractor shall inspect the AGSE upon delivery solely for purposes of identifying the AGSE and general verification of quantities and observation of apparent condition in order to ensure AGSE are acceptable and suitable for installation.

Such inspection will not be construed as final or as receipt of any AGSE and Services that, as a result of subsequent inspections and tests, are determined to be non-conforming.

2. Within three (3) days of such receiving inspections, Contractor shall provide Owner with written notice of Contractor's determination regarding conformity of the AGSE. In the event Contractor does not provide such notice, it will be presumed that the AGSE are suitable for Installation.

C. Inspection During Installation Process

1. The Owner's representative will conduct one or more inspections during the Installation process to review the Contractor's compliance with the Installation Specification and the rectification of any previously identified non-conformities. The Contractor shall supply the Owner's inspection representative with instruments and all such assistance as they may find necessary.
2. The Owner reserves the right to conduct these Installation inspections, unannounced and at any time during the Installation process.
3. If, on the basis of any inspections or testing, the AGSE or Services appear to be non-conforming, Owner will give Contractor prompt notice thereof will advise Contractor of the required remedies and the required completion date of such remedies.

D. Inspection at Final Acceptance

1. The Owner's representative will conduct a Final Acceptance Inspections when the Contractor has completed the Installation of the AGSE. The Owner's representative shall review all of the AGSE to ensure they are installed properly, that the Services have been completely carried out and that all previously identified non-conformities have been remedied. During this Final Acceptance Inspection, the Contractor shall conduct, with the Owner's representative as a witness, the specified on-site functional testing of the AGSE. The Owner's representative will identify any Punch List items that must be remedied by the Contractor during the Final Acceptance Inspection.
2. The Contractor shall provide seven (7) days written notice to the Owner of the proposed date of Final Acceptance and on-site functional testing.
3. If the AGSE are considered by the Owner to be Substantially Complete and useable for the intended purpose, the Contractor shall issue a Final Acceptance Certificate to the Owner. This Final Acceptance Certificate must list all identified Punch List items, must indicate a due date for the completion of the Punch List items, and must be approved by the Owner.
4. If the Contractor does not receive a signed Final Acceptance Certificate on the required date, as specified in the Contract Documents, the Owner may exercise delay penalties as called out in the Contract Documents.

E. Final Acceptance

1. Once the Contractor has remedied all of the Punch List items, the Owner shall be notified to re-inspect the AGSE and Services. Upon such notification, the Owner's representative shall re-inspect the AGSE and Services to verify the Punch List items have been remedied.
2. If any of the Punch List items have not been remedied to the Owner's satisfaction and subsequent inspections are required by the Owner's representative, the Contractor shall bear any and all costs, including labor, material, travel and per diem, incurred by the Owner to conduct such repeat FINAL ACCEPTANCE inspections.
3. If the Contractor does not remedy the Punch List items by the date identified on the Final Acceptance form, the Owner may exercise delay penalties as called out in the Contract Documents.
4. Once all Punch List items are remedied and accepted by the Owner, the Contractor shall issue a Final Acceptance Certificate, indicating the date the AGSE and Services have been accepted by the Owner. This date will also be the start date of the Contractor's Warranty Period.

END OF SECTION